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KIND WORDS.

The recent issuance of our Thirtieth Anniversary Number has been the subject of a great many kind letters and messages from readers and advertisers in this country, while we are now beginning to receive such congratulations in equal volume from abroad. Up to the present time, considerably over 500 such communications have reached us, and we feel that we can do no less than extend here our sincere thanks for these heartily appreciated expressions of esteem and good will.

UNDIGESTED EXPORTS.

While the country may have been suffering from the amount of "undigested securities" on hand, it would appear that the effect of financial dullness on foreign trade has not been serious, but that our exports of raw material, or "undigested exports," have continued heavy, and that the quantity of manufactures sent abroad, or "digested exports," has shown a notable gain during the past year. What is needed in this foreign trade is to lessen the "undigested" part of it by converting it into "digested," just as Europe does in her trade with us. She does not send us stuff in crude form and big bulk, but ships her goods in neat little packages; so that while the steamers may appear to come in light, a few pounds represent in value several tons of the raw material, in food, cotton, etc., that we may be sending across the Atlantic.

Meantime it is worthy of note that for the eight months including February the total exports from the United States were valued at one billion forty-eight million dollars against nine hundred and eighty-two millions, in 1903, while the imports fell off, representing six hundred and fifty-four millions against six hundred and eighty-one millions. A large proportion of this export is manufactures, being fully two hundred and eighty-eight millions as against two hundred and sixty millions in the previous period. The month of February alone showed thirty-eight millions against thirty-four millions in 1903. All this is very satisfactory in view of the depressed or agitated condition of more than one part of the globe. The electrical portion of this trade is holding its own very well.

SIMULTANEOUS TELEGRAPHY AND TELEPHONY.

In 1882, Van Rysselberghe—an ill-rewarded Belgian—first proposed the conjoint use of telephone circuits for both telegraphy and telephony simultaneously, and initiated ingeniously the use of composite circuits for such purposes. At the present time, a large number of long-distance telephone circuits are used for telegraphic purposes over and above their regular telephonic duty. The general and striking facts concerning composite circuits are fully set forth in the very interesting article by Mr. L. W. Stanton, on page 635. Broadly speaking, such a circuit passes both low-frequency telegraph impulses and higher-frequency telephone currents, receiving these in respectively selective branch circuits. It is curious to note that the signaling, or calling, telephone currents ordinarily belong to the low-frequency class, and that consequently special precautions are sometimes necessary to keep these telephone currents from interfering with the telegraph. Yet another kind of composite circuit not coming within the scope of the article, is the conjoint use of telephone receivers with telegraph apparatus under the name of the phonoplex system, which is in fairly extensive use. In this arrangement high-frequency impulses are used to actuate the telephone receivers for telegraphic instead of telephonic purposes.

These technical aspects and considerations have their value and importance, but they seem to us minimized, comparatively, by the commercial possibilities, outlined briefly by Mr. Stanton at the conclusion of his very suggestive article. The details given by him as to the amount of work already done in the application of the system will astonish most people, including not a few familiar with the twin telegraphic and telephonic arts. It is true that the figures quoted deal with what is going on in one section of the independent telephone field, but there could be a good deal said from the Bell side also, although the management have so far preferred to maintain an exuberant reticence as to what they are doing in that respect.

And this brings out the "political" aspects, as noted by Mr. Stanton as follows: "We cannot but expect to see two great telephone companies competing for both telegraph and telephone business, which will eventually bring about a consolidation between one of the telephone companies and one of the telegraph companies. This may compel an alliance between the two remaining companies, for the telephone and telegraph companies combined can reduce operating expenses very materially. The same official staff, the same buildings, the same conduit system, pole lines, etc., can be used by the two; and many other decided economies could be effected." There is food for thought here, especially as the idea is predicated upon such facts as those which Mr. Stanton sets forth.

Bell Telephone Figures

Very impressive are the statistics furnished by Mr. Fish as to the workings of the Bell telephone system last year, in his annual presidential report to the stockholders printed elsewhere. The financial condition is reflected in the ledger balances of $13,319,533 cash and deposits, and $22,397,407 bills receivable; offset by but $8,931,894 bills payable, nearly $3,000,000 of which was the dividend payable in January. The company earned $16,545,632, paid $8,619,150 in dividends and carried to reserve and surplus, $1,945,514. That looks like a pretty stable and comfortable business, whatever the "independents" may be doing—and they are doing a good deal. Indeed it is remarkable that the growth is so well kept up, and it is evident that whatever losses from competition are sustained in rural territories, the growth in the cities has fully offset them. The growth is also shown by the fact that new construction and real estate last year required a sum of $35,368,700. The increase in stations was 247,184 up to a total of 1,525,167, and the mileage of circuit increased 677,229 miles up to the splendid total of 3,958,891.

The Reciprocating vs. Turbine Types of Steam Engines.

During the past year or more the steam turbine has almost entirely monopolized attention in the field of steam engineering, and its advocates have not been sparing in setting forth invidious comparisons with the reciprocating type of engine, which, indeed, by some of these has been treated as already an anachronism. Perhaps this aggressive spirit has been fostered by the silence of those with whom lay the defense of the type attacked, but on another page we print an article in which at last the challenge is accepted and the issue most vigorously met. The case which Mr. Seymour makes out is a strong one, fortified as it is by data drawn, not from shop tests, but from the results of trials conducted by disinterested engineers. The remarkable efficiency of the engines tested, and particularly the efficiency at light load, shows that the reciprocating engine has had a margin of undeveloped economy which even in the recent past has been overlooked. The showing, in fact, is such that the steam turbine is put on the defensive as regards economy, and the issue presented can only be met by reports of tests under trial conditions and disinterested supervision similar to what obtained in the cases cited. Finally, all, we believe, will concur with Mr. Seymour that in general comparisons of performance of the reciprocating and turbine types of engines, the new-comer should select the latest development of the older type and not evolve for its purposes an "average" type—in other words, should squarely meet its real competitor.

Legal Aspects of Electric Affairs.

Mr. Ball's paper on this topic, printed elsewhere, gives an instructive view of some English precedents in decisions involving particularly the rights of operating companies. Although English and American decisions rest in general upon the same organic body of common law, yet the statutory provisions in the two countries are not always parallel and the general tendency of decisions is not precisely in the same direction. Mr. Ball deals with the liabilities of supply companies under the heads of negligence and nuisance. Now, from the general trend of recent opinions it is quite safe to assert that these two divisions as made here and in England would differ greatly in relative importance. The point of view here and there differs more than the statutes differ, and it is often the point of view that determines the final result. Broadly, the law regarding nuisances is far more rigorously applied in England than it is here. An operating company for electric supply, or in fact an industrial establishment of any kind, can seldom be successfully attacked here under the general principle of nuisances. Enjoining an electric light company on account of excessive vibration produced by its machinery, as was done in England the other day, would be difficult if not impossible in any American city. It has proved to be next to impossible here to really abate a smoke nuisance effectively. In general, the rights of the private citizen or private householder as against the acts of his neighbors are upheld very ineffectively, under American decisions. The idea of individual liberty is carried so far here that in practice a man may infringe the natural rights of his neighbors to a very objectionable extent without serious hindrance. Electric supply companies as a whole get the benefit of this sentiment in comparative immunity from a very annoying class of suits.

In another important particular the American plant has an advantage. In England there is a group of Acts dealing with the liability of employers and the rights of workmen in a fashion far more severe than any American statutes. On their faces English and American laws on these subjects are to about the same purport, but the former are backed up by a far more drastic series of decisions than the latter. We referred not long ago to a decision holding an employer responsible because a workman on the roof of a small building under construction was struck by lightning. Very likely the decision may be reversed on appeal, but it would have been practically impossible to get such a decision here, even in a jury trial much less from the Court. Juries are as a rule very liberal to employees who are injured, but they draw the line somewhere. On the other hand, so far as liability in case of injury to persons not employees is concerned, the American jury goes to considerable lengths. It will hold a company up in a matter of alleged negligence on very small provocation. Were it not for this tendency, fraudulent suits against street railway companies in particular would be far less frequent than experience has shown that they actually are. Sometimes claims of the most absurdly unjust character are successfully pushed, and the result is that operating companies have time and time again settled unjust claims out of court, knowing from bitter experience the treatment that they are likely to get at the hands of a jury. The "ambulance lawyer," so called, is a product of the easy jury, and much just complaint has been made of the practice of bringing suits ostensibly in the interest of the injured plaintiff, but really in the interest of the attorney. In such instances it seems to us that the fault lies largely with the forms of procedure that have gradually grown up.

We do not believe that the ordinary jury is hopelessly incompetent and prejudiced. On the other hand, it could by proper selection unquestionably be made very much better than it is. The ordinary jury is scarcely up to the level of the panel from which it is drawn, owing to the kind of selection which the respective attorneys have fallen into the vicious habit of making. Too many challenges and far too trivial causes are often allowed, and it seems to us that the firm exercise of a wise discretion by the Court could be and should be made to remedy the evil. The rules of evidence now in use are hardly suited to put the facts clearly before the jury that is obtained, and when there is, as not infrequently happens, an obvious effort on the part of the attorneys to keep pertinent facts from the ears of the jury, one can hardly expect to escape from questionable verdicts. But perhaps the most serious obstacle in the path of strict justice is the secrecy that often involves the real parties to the suit. As procedure now is, it is likely enough that while the ostensible parties are a grievously injured citizen and a wealthy and negligent corporation, the real parties may be an "ambulance lawyer" and a casualty insurance company. If the jury knew this they would be far less likely to be misled by unreasoning sympathy than is now the case. It is perfectly true that the jury trial has come to be looked at askance and held in some contempt, but the fault is not so much the fault of the system as of the way, cumbersome and indirect, in which it is worked. We are not aware that it works any better in England than here, perhaps not quite so well to judge from the large number of mistrials, but the fault is not inherent in the system. By and large, American electrical companies and interests are pretty well looked after by the laws, but the system is far from perfect, and we may as well keep our eyes frankly open to its defects with a hope of an ultimate remedy.

SHIELDED BALANCES.

On page 647 we print this week an interesting article by Mr. G. A. Campbell, which has many practical applications. When we measure the resistance of any conductor, say a coil of insulated copper wire, by the ordinary continuous-current Wheatstone bridge, we obtain a perfectly definite result, at any one temperature, if all the conductive connections are good, and if there are no appreciable leakages, or defects in insulation. If, however, we use an alternating-current Wheatstone bridge, the balance involves the magnitudes of both resistance and reactance. Unless both these quantities are balanced a perfect balance in the bridge is impossible. Moreover, if the telephone be employed as the measuring instrument in place of the galvanometer, it is most difficult to secure a complete zero of sound. This difficulty increases with the frequency, and at a frequency of 1,000 cycles per second, which is not high from a telephonic standpoint, Mr. Campbell shows that the dielectric susceptance of the air all round the apparatus plays a very appreciable part. In fact, air, while a perfect insulator for direct currents, is no insulator in this sense, for alternating currents. The alternating-current circuit is subject to all-pervading electrostatic susceptance, resembling leakage through the air; just as the magnetic circuit is subject to all-pervading magnetic leakage through the air. Air ceases, in fact, to be an insulator for the alternating-current circuit, just as in the magnetic circuit. The air acts in the same manner in both the alternating current and the magnetic circuits, that at all telephonic frequencies the energy is stored in the air elastically—electrostatically in the one case, and magnetically in the other—without any necessary waste in the process.

It is not merely the disturbance of the position of balance by the presence of the susceptance currents in the air, but also, as pointed out in the article, the liability to variation in the balance by such extraneous changes in the air currents as by the movements of the body of the operator. In such upper-frequency alternating-current bridge measurements, the operator may be said to have a personal equation that is not only mental, but also physical. The solution of the difficulty proposed by Mr. Campbell consists in making all the air susceptance currents definite and invariable, by enclosing the essential parts of the apparatus in metal boxes, or condenser shields. The various elements of the bridge are provided, as explained, with connected shields, and the entire apparatus is placed in a floating shield. This arrangement has the effect of adding certain definite susceptances to each of the conductances in the bridge; but these susceptances are at least invariable, and are capable of elimination in deducing the results of observations.

The plan somewhat resembles the expedient adopted in electrometers of the attracted-disc type. The force attracting two opposed parallel plane surfaces or discs at a definite distance apart in air, for any given difference of potential between them, is known to be $e^2/8\pi$ dynes per square centimeter, where e is the electric intensity in abstatvolts per centimeter. Near the edges of the discs, however, the electric intensity is weakened, and bent out of the perpendicular, in a complicated manner. In order to restore definiteness and simplicity to the arrangement, a guard ring is arranged so as virtually to extend the plane surface of the disc, and keep the electrostatic flux density sensibly uniform all over the surface of the disc, where the attractive force is measured. In a certain sense the expedient given in the article for restoring definiteness and simplicity to the alternating Wheatstone bridge, consists in supplying virtual guard rings to all the apparatus capable of being affected by the alternating electrostatic flux. In wireless telegraphy and in researches on Hertzian waves, the detecting apparatus has frequently to be included in metallic boxes to keep electrostatic waves *out*. In the case here considered Mr. Campbell places his apparatus in metal boxes to keep electrostatic waves *in*.

We shall hope to receive a subsequent article from Mr. Campbell giving the results of the practical use of the apparatus. We regard this article as of importance, not merely from its technical value, but also as marking what is in our judgment a decided advance in the policy of the long-established telephone industry. We have long been aware that telephone engineers have carried on valuable and important technical researches in connection with their work, which researches the telephone administration always decided to withhold from publication, as a matter of policy. This policy we have always protested against as short-sighted, imprudent and immoral. None will deny that an industry has a perfect right to withhold trade secrets and manufacturing data that may have cost time and industry to acquire. We offer no criticism against the policy of withholding trade secrets, and none would be likely to be influenced by such criticisms if offered. But when the matters relate merely to technology, or applied science, as distinguished from business or manufacturing details, we think everyone will agree that there is no use in withholding from publication matters which the general progress of science will inevitably make known within a few years at most, and which if made known only redound to the credit of the industry disclosing, while adding to the world's general stock of knowledge in applied science. When the knowledge is arrived at by outsiders, in the regular subsequent course, the original work done earlier by the industry has lost credit, and has lost the evidence of progress. The time has gone by, let us hope, forever, when a chemical formula, like that of Greek fire, could be kept a secret in the arsenal of Constantinople for nearly six hundred years. For the above reasons we welcome Mr. Campbell's article as a contribution of telephone engineering to technology, which is a good augury for future policy.

Tesla Split-Phase Motor Patent Decision.

Judge Kohlsaat on Saturday of last week handed down a decision in a case involving the Tesla split-phase motor patent brought before the U. S. Circuit Court for the Northern District of Illinois, which decision upholds the Tesla patent and grants an injunction against the use of the split-phase principle in a wattmeter made by the defendants in the action. The opinion cites the opinions of Judges Archbold, Hazel, Townsend and Lacombe sustaining the patent, and the opinion of the Court of Appeals reversing the Lacombe decision, which latter ruling was followed by Judge Colt in another case. All of the above cases have been reported in these columns.

Judge Kohlsaat says that the decision of Judge Lacombe was reversed largely upon the ground that it did not appear from the record that Tesla's invention was not anticipated or described in a paper read by the late Prof. Ferraris before the Royal Acadmy of Sciences, of Turin, Italy, on March 18, 1888, and published, in part, in an electrical journal issued at Milan on April 22, 1888. He holds, however, that in the later cases—those decided by Judges Archbold and Hazel—the records, together with certain original proofs offered in the present case, establish that Tesla's invention in suit antedated the Ferraris article, was original with Tesla, and that his patents are valid.

Discussion of Institute Papers.

The regular monthly meeting of the American Institute of Electrical Engineers last Friday was devoted to the discussions of papers of Messrs. Blackwell, Stillwell, Hewlett and Moody, full abstracts of which were printed in our issue of March 19. The following council nominee ticket for the coming election was announced: President, Mr. John W. Lieb, Jr.; vice-presidents, Messrs. W. E. Goldsborough, J. J. Carty and Samuel Reber; managers, Messrs. L. A. Ferguson, H. G. Stott, J. G. White and S. S. Wheeler; secretary, Mr. R. W. Pope; treasurer, Mr. G. A. Hamilton.

The discussion of the papers of the evening was very extensive, as may be judged from the fact that a transcript in full would cover about 12 of these pages. Consequently, it is only practicable to give here a mere summary, the reader being referred to the report in full, which in due course will be published by the Institute.

Those taking part in the discussion were Messrs. Chesney, Perrine, Dow, Peck, Townley, Mershon, Skinner, Arnold, Stott, Scott, Nunn, Lincoln, de Muralt, Lyford and Stillwell. Written contributions to the discussion were submitted by Messrs. Tobey, Hazard, Roberts, Bayne, Walters, I. A. Taylor, D. C. Jackson, Wright, J. B. Taylor and N. M. Snyder.

The greater part of the discussion of the evening was on the relative safety with respect to fire risk, of oil and air-cooled transformers, and provisions that should be made to reduce the fire hazard in the case of the former. The opinion was almost unanimous that the oil transformer, if proper precautions are taken, is safer than the air transformer. In support of this view, Dr. Perrine mentioned that the fire underwriters, and particularly the instructions of the Mutual Fire Insurance Company, favor the oil over the air-cooled transformer. Mr. Peck stated the case against the air-blast transformer, which he said is more susceptible to damage by fire from static discharges, arcs, bad contacts, etc., than the oil-insulated transformer; though, he added, on the other hand, owing to the small amount of combustible material in the former, it is possible to have such material entirely destroyed with comparatively little fire risk to neighboring apparatus or buildings. As to precautions to be observed in installating oil transformers, all concurred that the case should, where possible, be made of riveted boiler iron which will withstand a pressure of 100 pounds per square inch, and that it should be properly vented. Mr. Peck said that where sheet iron construction is necessary the case should be made practically air-tight and provided with a very large safety valve, so that an internal explosion cannot burst the case. It was generally agreed that transformer units should be located in fire-proof compartments and some advocated locating them in vaults. In any case the transformer case should be so constructed as not to be broken in the case of the floor or walls of a burning building or heavy weights falling upon it.

Mr. Mershon disapproved of a bottom drain, owing to the fact that as oil went out air would enter the transformer case, and might cause an explosion. He described an arrangement which he had used which provides for pumping water into the bottom of a transformer, which forced the oil out at the top. He dwelt upon the necessity of so arranging the draining system that in case of falling floors or walls the pipes would not be broken. One suggestion was that the transformers should be placed in vaults that could be closed and to which steam could be admitted to smother flames in case of the oil taking fire. Several of those taking part in the discussion drew attention to the fact that the oil-cooled transformer was not an extreme fire hazard, if proper precautions were observed, and that this should be made plain in order that the discussion would not cause alarm.

The matter of transformer terminals was considered in the discussion. Mr. Skinner pointed out the difficulty of bringing out such terminals from transformers of 20,000 volts or more. This trouble was increased when there were requirements for combinations of transformer voltages and where high-tension windings were to be tapped for regulating purposes. The terminals should be brought through porcelain insulators with the lower ends located beneath the level of the oil in the transformer. In the installation to which Mr. Mershon referred the terminals were brought through stuffing boxes in order to make the case air-tight. Mr. de Muralt said that in Europe the air-blast transformer is considered a greater fire risk than the oil-cooled transformer. The desirability of fire-proofing the buildings of electrical plants was illustrated by Mr. Lyford, who cited the fact that the only two buildings left intact in the Baltimore burned district were the new power house and sub-station of the electric company. Mr. Hazard suggested sealing the space above the oil in the transformer with an inert gas such as carbon dioxide supplied by a gas generator. One suggestion was that the oil used in transformers should have a fire test of approximately 400° F., and another that it should have a flash test not below 175° C., as in that case there would practically be no evaporation at 100° C. Mr. I. A. Taylor said that in the case of transformer terminals he had used a porcelain tube filled with sulphur, and he advocated that transformer cases should be adequately grounded to prevent fire and for personal safety. Marble terminal boards were generally criticised.

In the discussion on high-tension switches, Mr. Chesney, after classifying such switches into four types, concluded that the oil switch in the present state of the art is the only one to be used in high-tension work, and he laid down a number of requirements in connection with such switches. Dr. Perrine described some experiments with oil switches on the 40,000-volt line of the Standard Electric Company in California. The full load of four 2,000-kw machines was broken a number of times by such switches, in every case satisfactorily opening the circuits. Mr. Alex Dow favored oil over air switches. As to switching, he considered that while in some cases the conditions permit the running of everything on the same set of mains in multiple, the general condition, however, indicated their separation into groups. Mr. Mershon expressed the opinion that the oil switch is at least as reliable as the apparatus which it controls up to 10,000 volts, but he does not consider it necessarily a final development, since it is not yet entirely adapted to high-voltage work. Mr. Stott said he looked upon group switches in the light of an insurance against interruptions of service, which insurance had to be paid for in complication and first cost. Mr. Scott considered that the air switch still has a large field where the voltages are large and where the oil switch is expensive to install. Mr. P. N. Nunn said he could not defend the air switch as in the 40,000-volt Provo plant such switches are being displaced as rapidly as possible by oil switches. Mr. de Muralt favored the oil type switch, but considered the horn type of switch as applicable in special cases.

In the discussion on group switches, Mr. Stillwell said that if in a plant there should be three shut-downs in the course of a year from using single switches, it would be better to install group switches and eliminate the shut-downs entirely. Prof. D. C. Jackson criticised the arrangement of group switches described by Mr. Stillwell as being of limited usefulness, and said that an arrangement whereby individual circuits are brought directly to the main bus-bars is usually to be preferred. Mr. I. A. Taylor considered that the advantages enumerated for group switches might be more simply and cheaply obtained by the use of multi-point control switches used in parallel with the ordinary ones. Mr. Gilbert Wright was of the opinion that group switches and duplicate buses involve a cost much too large in proportion to the results obtained. Mr. John B. Taylor commented in detail upon the various considerations put forward by Mr. Stillwell concerning the use of group switches, his comment in general being adverse to use of the system except where the conditions specifically indicate its advantages. He advocated an arrangement which is essentially a single main bus-bar and a series of group buses, which may be interconnected to form a reserve main bus in case of trouble or to facilitate work upon the main bus.

Simultaneous Telephone and Telegraph Equipment.

BY LE ROY W. STANTON.

THE apparatus entering into the equipment of a modern long-distance telephone line includes not only special telephone apparatus, but also apparatus for making practical the use of the telegraph in connection with the telephone, so that simultaneous telegraphy and telephony may be accomplished.

The revenue derived from telegraph leases on long-distance telephone lines, in many cases equals, and quite often exceeds that derived from the long-distance telephone service. While this practice is not new, its application has not been extensive, owing to the meagre knowledge of the principles, and the limited number of

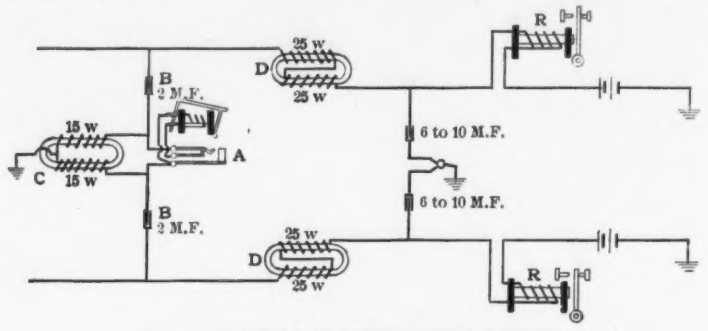


FIG. 1.—DIAGRAM OF COMBINATION CIRCUIT.

long-distance telephone lines. The successful operation of the system depends upon the proper proportion and arrangement of inductance and capacity. The effect of high and low-frequency currents upon impedance coils and condensers being directly opposite. The comparatively slow vibrations of the impulses in a telegraph circuit pass readily through the impedance coils, but are almost totally obstructed by the condensers, while on the other hand, the vibrations set up by the voice in the telephone transmitter, produce in the line a current of very high frequency, which has a directly opposite effect upon the condenser and impedance coils arranged in the circuit.

Fig. 1 shows diagrammatically the arrangement of the circuit where each side of the line is used as a separate telegraph circuit, and the two circuits or sides of the line form a metallic circuit for telephone purposes. *A* represents a telephone set, *B* a two-M.F.

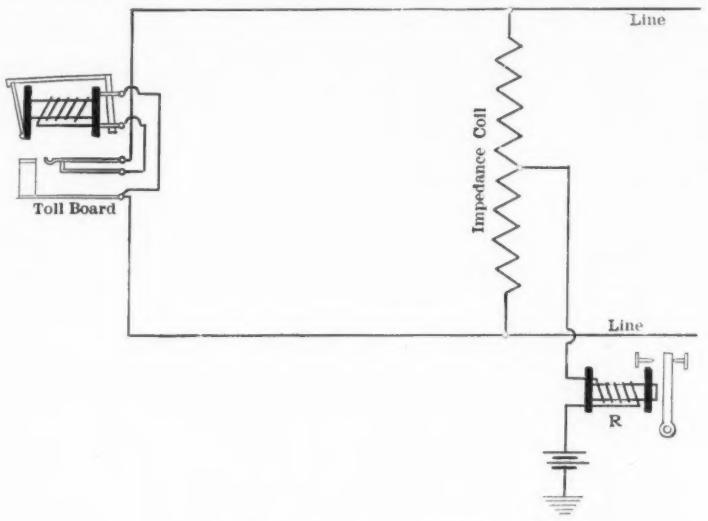


FIG. 2.—CIRCUIT WITH IMPEDANCE COIL.

condenser, *C* an impedance coil wound to 30 ohms. The coil is large and massive so as to have a high inductance. The core is composed of a complete iron circuit, and the windings are wound on two spools and so connected as to give the greatest impedance to voice currents, this being necessary, as the coil is bridged in parallel with the telephone set across the line; the function of the coil is to reduce the click from the telegraph circuit, caused by the opening and closing of the telegraph key, which produces a rise and fall of potential on the line, and tends to charge and discharge the condensers, which are in series with the telephone set across the line. This coil being grounded in the center allows the condensers to discharge to ground through one-half of the coil instead of through the telephone set to ground on the other side of the line.

If *r* represents the resistance of one-half of the coil, *C* and *L*, its inductance then to the slow discharge current from the condenser to the ground, due to the making and breaking of the telegraph circuit, its total impedance to ground will not much exceed its resistance, *r*, which in this case is 15 ohms. But the telephone current has a very high frequency, and owing to the high inductance of coil *C* almost the total telephone current passes through the telephone set. The total impedance to the voice currents through coil

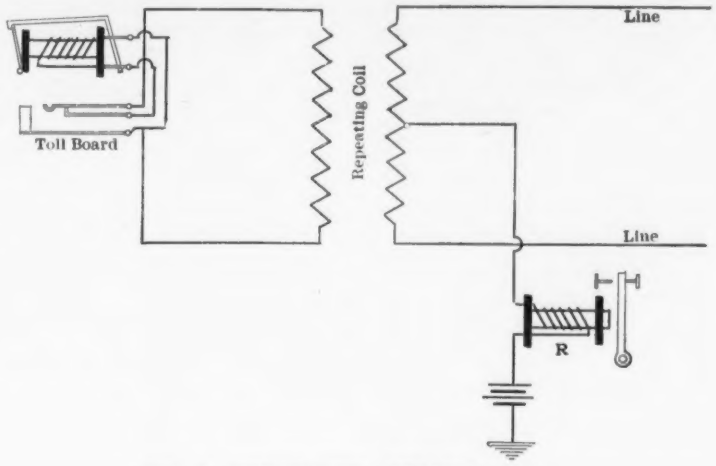


FIG. 3.—CIRCUIT WITH REPEATING COIL.

C may be expressed by the formula: Impedance $= \sqrt{R^2 + (2\pi n L)^2}$ in which *n* is the frequency and *L* the inductance. The average value of *n* is about 1,000. Taking the value of *L* at 10 henrys, the impedance $= \sqrt{30^2 + (2 \times 3.1416 \times 1{,}000 \times 10)^2} = 62{,}832$ ohms. In this case *r* (30 ohms) is so small compared to the reactance that it does not appreciably affect the result, 62,832 ohms, at all and could just as well be neglected. Coil *D* is similar to coil *C*, but is wound to 50 ohms. The two windings on this coil are connected so that the inductive reactance of the two coils oppose each other. This is very important, for it has been determined by trial that otherwise the self-induction from this coil in making and breaking the telegraph circuit causes a very perceptible click in the telephone.

Fig. 5 represents diagrammatically the form of the current wave when the telegraph current passes through a coil having a very high coefficient of self-induction. Upon the breaking of the telegraph circuit by the key, the potential instantly rises, which causes the high

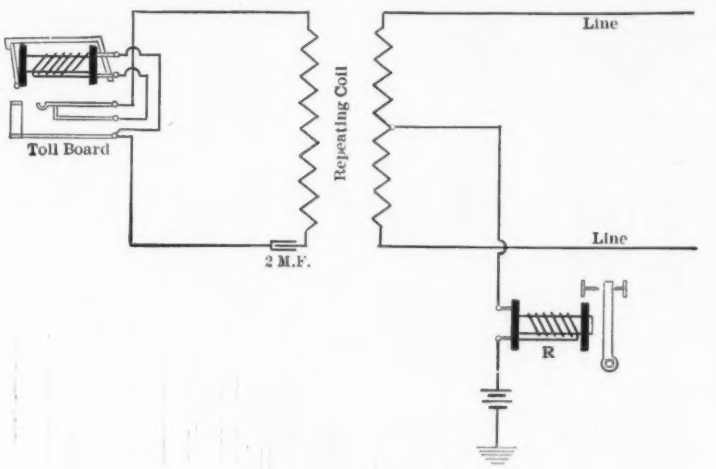


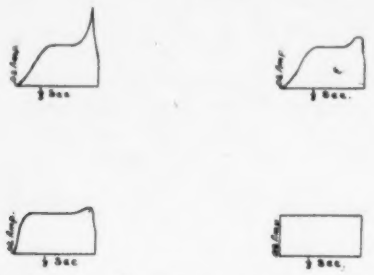
FIG. 4.—CIRCUIT WITH REPEATING COIL AND CONDENSER.

peak. This high instantaneous voltage is what produces the very severe click in the telephone set and very materially interferes with the use of the telephone. If the two windings of this coil are connected so that the inductive reactance of the coils neutralize each other, there is a very slight click in the telephone set and the lag in the telegraph circuit is very materially reduced. The sluggish working of telegraph instruments is very noticeable when there is a high inductance in the circuit of the telegraph sets. Fig. 6 represents the form of current wave when the coils are connected so as to neutralize each other. Fig. 7 illustrates diagrammatically the form of the current wave in an ordinary telegraph circuit in which the current rises almost instantly from zero to its maximum strength when the key is closed, and then remains constant or continuous

about the duration of the signal and then falls suddenly to zero when the key is opened. Fig. 8 represents the form of current wave in a telegraph circuit in which there is no inductance or capacity.

While the inductive reactance of the two windings of coil D to the comparatively slow oscillation in the telegraph circuit tends to neutralize each other, owing to the neutralizing effect of the windings, it is not so with the high-frequency voice currents; for here the rate of oscillation is very high, and as a matter of fact the effect is comparatively the same, whether the coils are connected to neutralize each other or to give what would be expected to be the greatest inductive reactance.

The impedance of the coil to the telegraph current would not much, if at all, exceed its resistance. For the impedance =



FIGS. 5, 6, 7 AND 8.—FORMS OF CURRENT WAVES.

$\sqrt{R^2 + (2\pi n L)^2} = R$; since the current circulates in opposite directions through the two coils around the same iron core. If the windings were not exactly balanced, the impedance would be a little greater than R, but not much even then, because n is comparatively low, not over about 15 per second.

While the above is true of slowly changing currents, it does not apply to extreme high-frequency currents. The core of coil D forms a complete magnetic iron circuit, and is large and massive, which makes it sluggish. This prevents a complete reversal of its magnetism throughout the whole core when the very high-frequency telephone currents tend to reverse it; therefore, instead of one complete magentic circuit we have two. The lines of force set up in each coil find a return path through the air rather than through the iron; moreover, the two coils oppose each other inductively, which further tends to make each coil and its core act as an independent impedance coil. Such being the case, we have two similar impedance coils in series to oppose the telephone current. The impedance of the two coils in series is given by the formula:

$$\sqrt{(2R + 2R)^2 + (2\pi n L + 2\pi n L)^2} = \sqrt{(R)^2 + (4\pi n L)^2}.$$

The proper arrangement of condensers and their capacity is also

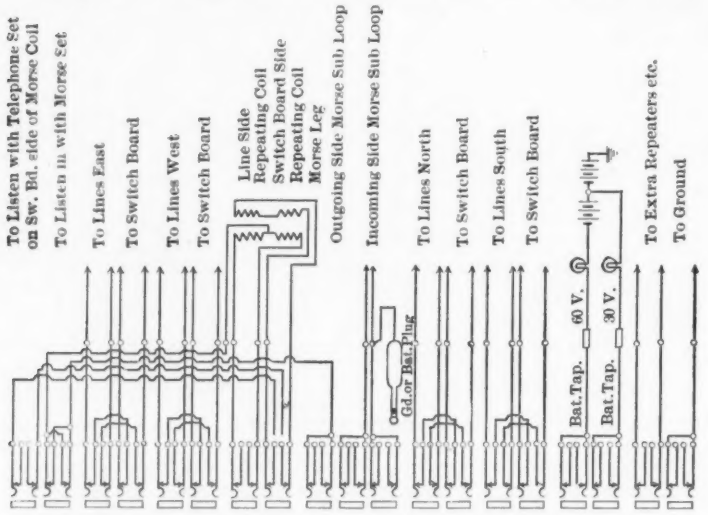


FIG. 9.—TEST PANEL USING REPEATING COIL FOR MORSE WORK.

quite important. The greater the capacity of a condenser within certain limits, the more efficient it becomes for transmitting speech. For this reason, a large capacity condenser would naturally suggest itself for use in series with the telephone set, which is bridged across the line. Experience has proven that if a large condenser is used in this connection, that it causes quite a perceptible disturbance from the telegraph in the telephone set, due to the fact that the greater the capacity of the condenser the larger the charge and discharge as the potential on the telegraph line rises and falls when the key is closed and opened. The larger charge and discharge currents flowing between the condenser and ground, produce, of course, a greater variation of potential in the circuit in which the receiver is connected. Thus the telephone receiver is interfered with if the capacities of the condensers B and B' are too large.

The condensers which are bridged to ground, between the im-

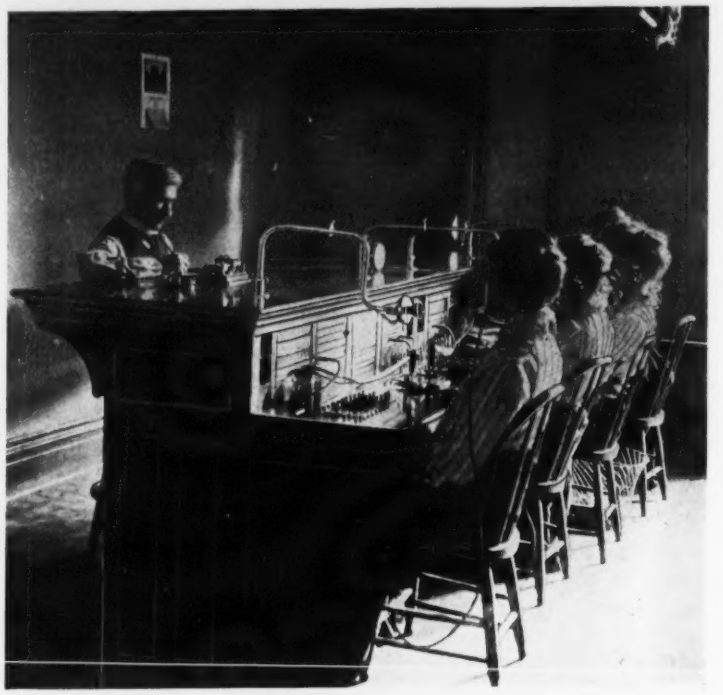


FIG. 11.—TICKET WIRE OPERATOR AND LONG-DISTANCE TELEPHONE OPERATORS.

pedance coils and telegraph instruments, should be from six (6) to ten (10) microfarads. The greater the capacity of these condensers, the less the disturbance in the telephone circuit from the telegraph.

It is sometimes advisable to bridge the telegraph key with a two (2)-microfarad condenser, which absorbs the sudden rise of potential due to the self-inductance of the line and coils when the circuit is broken by the key, thus preventing a sharp fluctuation on the line tending to cause a disturbance in the telephone set.

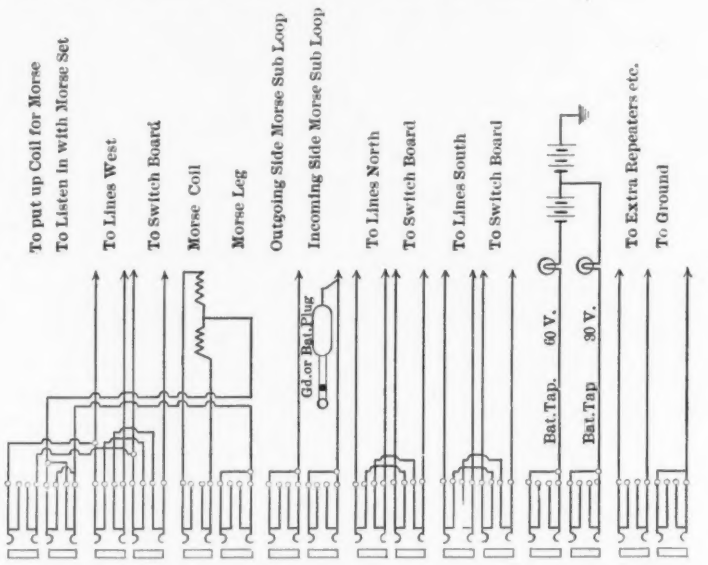


FIG. 10.—TEST PANEL USING IMPEDANCE COIL FOR MORSE WORK.

The above arrangements of circuits and apparatus gives a very satisfactory service, both from a telegraph and telephone standpoint, and admits of the use of a pair of wires for carrying on intelligence between three pairs of parties at the same time, without interference, which very materially increases the earning powers of a long-distance line. The principle disadvantage of the system is the difficulty of securing suitable signalling apparatus between the telephone operators. Signalling over a composited long-distance line in the ordinary way with telephone generator seriously interferes with the tele-

graph service and does not signal the distant telephone operator, owing to the comparatively low frequency of the regular generator, and the arrangement of the apparatus in the circuit.

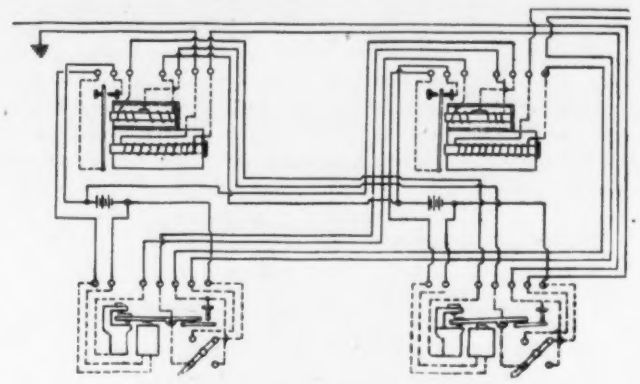


FIG. 12.—WIRING OF WEINY-PHILLIPS REPEATER.

The slow alterations of the signalling generators are somewhat impeded by condensers B and B', and shunted from the line drop in the telephone set by coil C, which does not offer a very high impedance to a 16-cycle ringing current, but if a 133-cycle or even a 60-cycle current is used, there is no interference to the telegraph service, and the signalling between telephone operators is positive if a properly designed line drop is used.

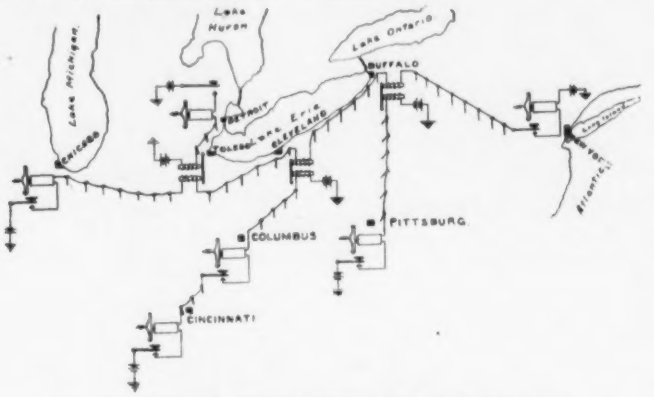


FIG. 13.—DIAGRAM OF THROUGH LINES AND BRANCHES.

Within the past few months there has been installed on some of the long-distance lines apparatus that enables the ordinary ringing currents to be used; the ringing currents being passed through a vibrator, which in turn passes through a small transformer, the secondary of

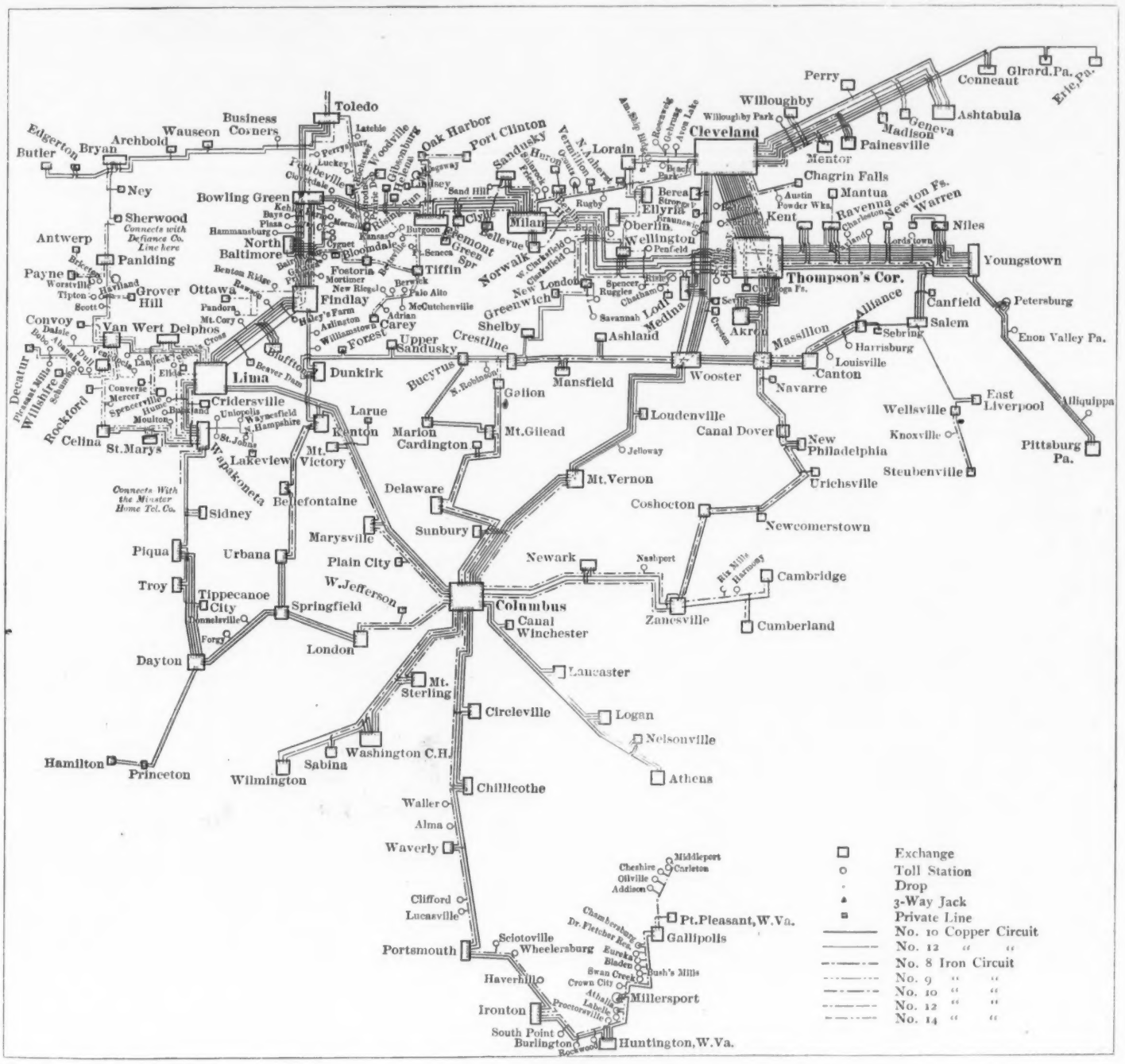


FIG. 14.—CIRCUIT MAP, UNITED STATES TELEPHONE COMPANY.

which delivers to the line a comparatively high-frequency current, which operates a specially-designed relay, which in turn operates the line drop, thus signalling the operator at the distant station.

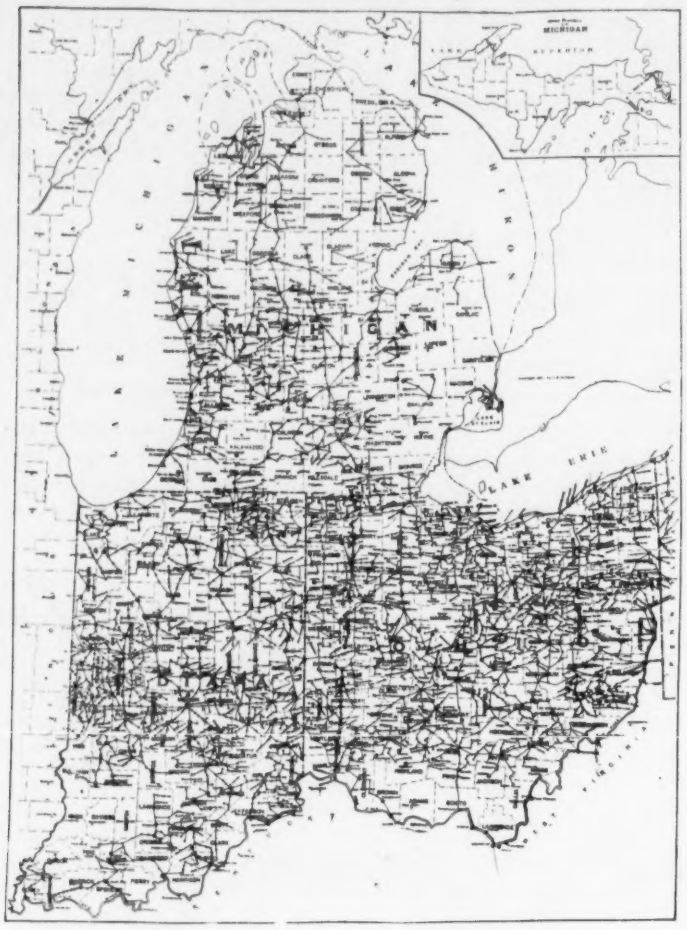


FIG. 15.—MAP OF TOLL LINES IN MICHIGAN, INDIANA AND OHIO.

The disadvantage of the high-frequency currents is that they tend to produce noise on the lines. When lines are composited, the telephone connections are usually ordered up by telegraph or order

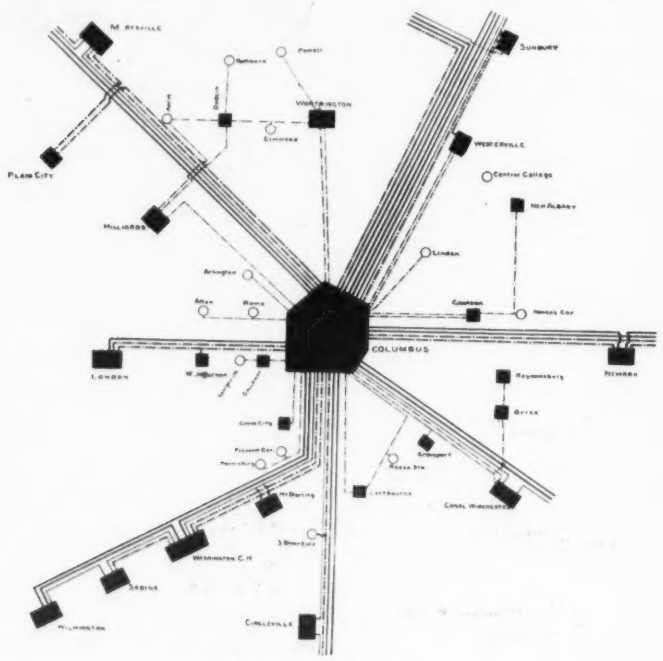


FIG. 16.—TROUBLE DISTRICT.

wire, most generally by the telegraph. Fig. 11 shows view of a ticket wire operator sitting at the rear of tollboard, making appointments and ordering up telephone connections by telegraph.

Fig. 2 shows another method of using a telephone line for telegraph purposes. This system possesses advantages as well as disadvantages over the one so far described. It is much cheaper to install, but it requires both sides of the line to make one telegraph circuit. It possesses, however, the advantage of the telephone operator being able to signal in the regular way without the use of special apparatus. The impedance coil, which is bridged across the line, has very low resistance, but high inductance, which prevents the voice currents from being short-circuited. The telegraph circuit being tapped in the center of the winding of the impedance coil, there is no inductance to oppose the telegraph current and to produce

FIG. 18.—REPEATER AND SWITCHING STATION, TOLEDO, OHIO.

a lag in the telegraph circuit, which tends to make the telegraph instruments act sluggish. The principal disadvantages of this system are: First, there can be but one telegraph circuit derived from each telephone circuit; second, the interference to the telegraph service by telephone operators signalling with ringing generators, which become accidentally grounded or which are permanently grounded. This trouble could be remedied by using a special generator at the terminus of the Morse lines, if it was not for the fact that the same circuit is often connected to other long-distance telephone lines, which extend to scores of other offices, any one of which, by ringing with a grounded generator, interferes with the telegraph service. A third objection is that unless condensers are used between the impedance coil and the terminus of the line on the tollboard, the Morse circuit is liable to become grounded, and interfere with the telegraph service by a telephone operator connecting this circuit with another long-distance line, which is accidentally grounded. The last two conditions can be eliminated by terminating the telephone lines, which are also used for Morse work on smaller size jacks on the tollboard, and using connecting cords, which have repeating coils in circuit, and which terminate on large

FIG. 17.—REPEATER AND SWITCHING STATION, THOMPSON'S CORNERS, O.

and small-sized plugs. This slightly interferes with the rapid handling of telephone traffic and cuts down the talking efficiency of the line, to some extent, but effectually prevents interference to the telegraph service.

Fig. 3 shows the use of a repeating coil for deriving a telegraph circuit from a telephone circuit. This system possesses the advantage of operators being able to signal each other with an ordinary generator, providing it has sufficient voltage and output, and there is no interference to the telegraph service in case the derived line is connected with a line which is grounded. The telephone service

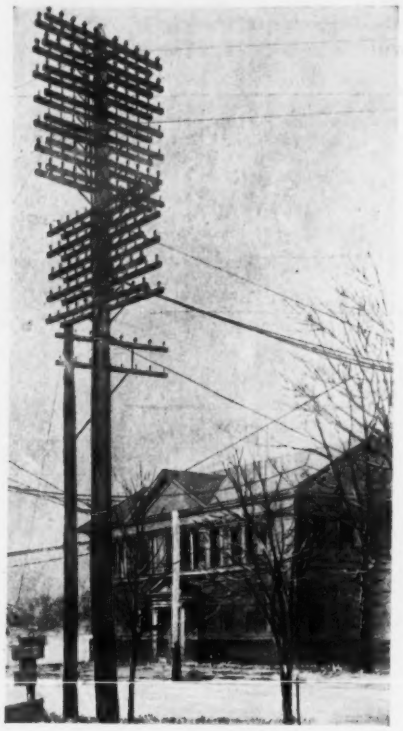


FIG. 19.—TERMINAL POLE SHOWING LEADS.

over this system is very inferior owing to the number of repeating coils which are liable to be used if the telephone circuit is of any great length and built up at a number of stations.

The repeating coils used in this system have to be specially designed so that they will transmit the ringing current, otherwise the telephone operators would not be able to signal each other. Such

terfering with the telephone service. This is caused in three ways: First, if there is an escape caused by a slight ground on one side of the line, it causes a greater flow of the telegraph current through the winding of the repeating coil that is connected to the side of the line from which there is an escape. This allows the click of the telegraph to be heard in the telephone. Second, if one side of the line is of higher resistance than the other, which is always the case

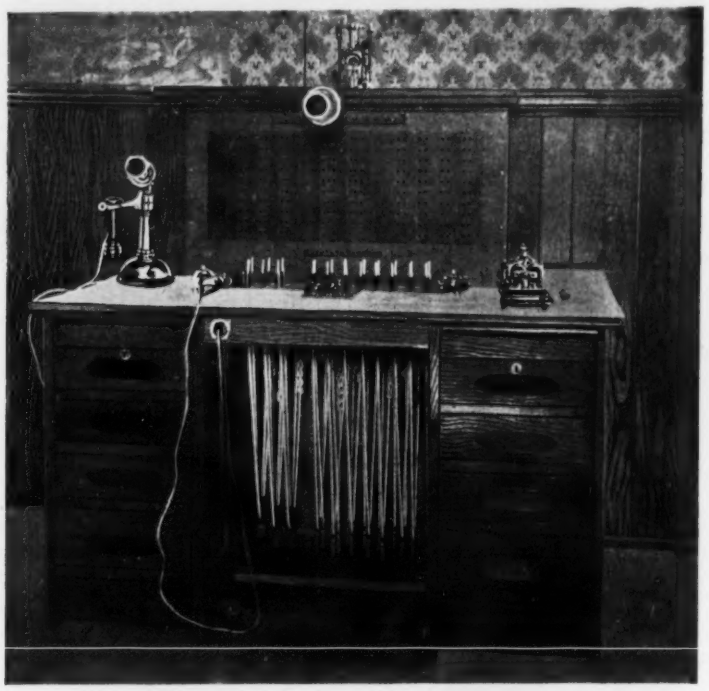


FIG. 21.—TEMPORARY TEST PANEL, TOLEDO, OHIO.

to a greater or less extent, it causes an unequal division of the current which produces a disturbance, as above mentioned. The same disturbance is noticeable if the windings of the coils are not perfectly balanced.

The circuit illustrated in Fig. 4 is the same as Fig. 3, except that there is a 2 m.f. condenser in series wihh the coil leading to the toll-

FIG. 20.—VIEW OF WIRE CHIEF'S ROOM, THOMPSON'S CORNERS, O., SHOWING REPEATER TABLES, TEST PANEL AND PORTION OF COIL RACK.

coils, while efficient for ringing purposes, are quite inferior for transmitting the voice currents, with their high frequencies.

The system also has the disadvantage of the telegraph service in-

board. It has been found that a condenser so placed assists in throwing the line drop.

Figs. 9 and 10 represent diagrammatically the wiring of what is

known as a Morse test panel. Fig. 9 represents the method of wiring where repeating coils are used, and Fig. 10 represents the method of wiring where impedance coils are used. Wiring for composite work is somewhat more complicated owing to the fact that each side of the line is used for a separate telegraph circuit. The wiring of these test panels must be such that great flexibility is secured in building up circuits and replacing breaks in a long line. If a New York-Chicago composite circuit gives trouble, the wire chiefs at the various switching stations along the line must be able to immediately locate the trouble and remedy same. The section which is in trouble will be located between two switching stations. This portion of the circuit must be discarded and another wire from some other circuit substituted without a moment's delay, as the telegraph circuits are kept busy by brokers and other classes of important business, in which a slight delay often means considerable loss. For to give a thoroughly reliable service the company should have several different leads throughout the country over which to route the business in case one lead wire was entirely broken down by a sleet storm, etc.

The test panels are equipped with instruments for making tests for locating trouble and listening in on telegraph lines to see if same are working properly. The wire chief must be able, by listening in with a telegraph instrument, to determine whether there is a swinging ground on the line, an escapement, insufficient battery, etc., and be able to remedy same without delay. (Morse wire chiefs become very expert in detecting the slightest trouble by listening to a Morse instrument.) The test panels are so wired that a line between New York and Chicago which is being used in sections for telephone work; for instance, between New York and Buffalo, parties may be carrying conversation over one section, Buffalo-Toledo parties using another section, and Detroit-Chicago parties using another section, and at the same time the entire line is being used as

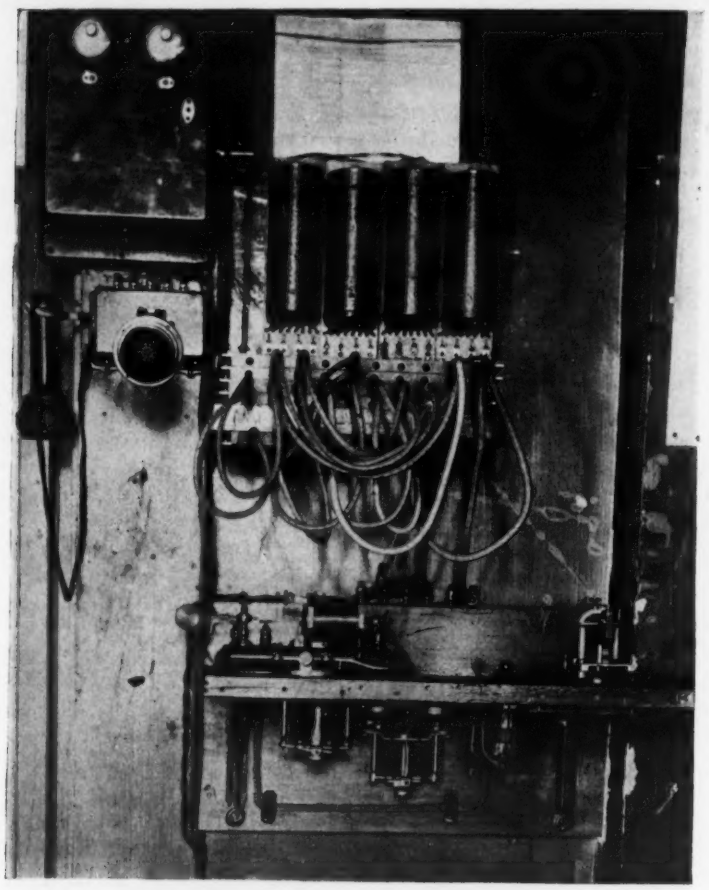


FIG. 22.—EQUIPMENT USED IN SMALL SWITCHING STATIONS.

one complete telegraph circuit. It is also practicable to use one side of one line in one section and another side of another line in another section to make up one complete telegraph circuit without interference in any way.

The test panel is also arranged so that any voltage which may be required up to 120 volts can be cut into any telegraph circuit. This is accomplished by the means of storage batteries located in the switching stations. Various voltages are used according to the distance between the stations and the number of instruments in circuit and the amount of leakage. However, with too high a voltage there is a greater liability of the telegraph interfering with the telephone. Arrangements are such on the test panels that repeaters can be cut in or out according to the requirements, and side line repeaters added, if necessary. The wiring of the Weiny-Phillips repeaters is shown in Fig. 12.

Fig. 13 shows diagrammatically a through line between two terminal points with branch lines taken off at intermediate cities. In

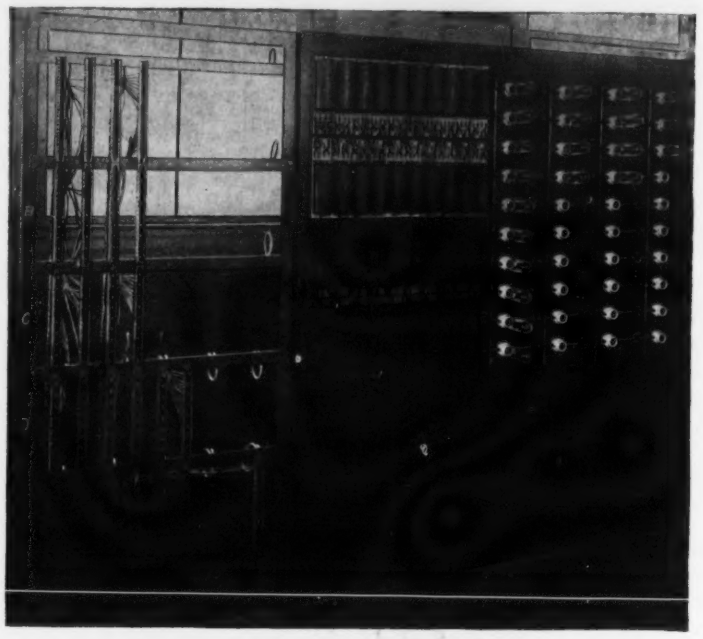


FIG. 23.—VIEW OF CROSS-CONNECTING RACK, MORSE COILS AND BATTERY RESISTANCE LAMPS.

newspaper work, for instance, between New York and Chicago, a number of cities not directly on the line, receive the service over a signal branch line from the main line, while the main line remains continuous. At the point where the branch is made, a side line repeater is used. If a loop was used double the mileage of wire would be necessary to serve the branch cities and in addition there would be added considerable impedance to the circuit and a greater liability to trouble, such as breaks, grounds, etc.

The geographical location of long-distance switching or repeater stations is a very important matter both from a telephone and telegraph standpoint, and from a point of economy in buildings, equipment, and in superintendance, they should be located at the same place. These stations should be located near and on direct lines between the large business centers and at distances from three to four hundred miles apart. From a telephone standpoint, it is much more economical to have the long-distance lines divided into sections, for instance from Chicago to New York or Boston, the line should be in sections; say, from Chicago to Toledo, from Toledo to near Buffalo, Buffalo to Albany, Albany to New York or Boston. If the telephone circuit was continuous, the company would be unable to receive as high earning powers from the line. By being divided into sections, each section is capable of transacting a toll business between intermediate cities when the line is not in use between the terminal points. This very materially increases the earning powers of the line. From a telegraph standpoint, it is quite often necessary that the line be continuous. Unlike the telephone, the telegraph is more efficient when repeaters are located every three or four hundred miles along the line. By means of automatic repeaters and separate sets of batteries for each section of the line, telegraphing is carried on more satisfactorily than when a continuous circuit is used. The earnings of long-distance lines are oftentimes more than doubled by being able to telegraph over the same line at the same time. The rental usually charged is $20 per mile per year for 12 hours' service and $30 per mile per year for 24 hours' service. The American (Bell) Telegraph & Telephone Company base the distance on which to charge on the railroad mileage. The Independent United States Telephone Company base their mileage distance on the air line distance between the cities receiving the service. The distance between New York and Chicago is approximately one thousand miles. At

$20 a mile per year the rental for one side of a telephone line for telegraph purposes would be $20,000. As a matter of fact, there are a number of telephone circuits between New York and Chicago for which brokers, newspaper companies and large business interests pay $18,000 a year for a single wire, which brings the earnings of a telephone circuit for telegraph use up to $36,000 per year. In addition to a very large toll earning from the use of the long-distance telephone, a telephone company is at very little additional expense when supplying telegraph service, or what is often termed leased wire service, as the parties who lease the service supply their own telegraph operators. The maintenance of the line is practically the same whether the telephone lines are used for telegraph purposes or not. The copper circuit furnished by long-distance telephone companies are much superior to the ordinary iron wire used by the telegraph companies. The United States Telephone Company, whose offices are in Cleveland, Ohio, has several thousand miles of long-distance telephone line, over which they are doing a very heavy simultaneous telegraph and telephone business, having leased lines to a number of brokers in Cleveland and other cities, such as Pittsburg, Pa.; Youngstown, Ohio, and Columbus, Ohio. Their lines also carry the bulk of telegraph work done by the Associated Press in Ohio, and some business for the Steel Corporation between Cleveland, Ohio; Pittsburg, Pa.; Wheeling, W. Va., etc., as well as for some of the coal mining companies. They have been successfully carrying on this line of work, now, for more than two years. The simultaneous telephone and telegraph equipment was put in operation by the writer while engineer for the United States Telephone Company.

Fig. 14 shows a circuit map of the United States Telephone Company's lines in Ohio. This territory is subdivided into districts over

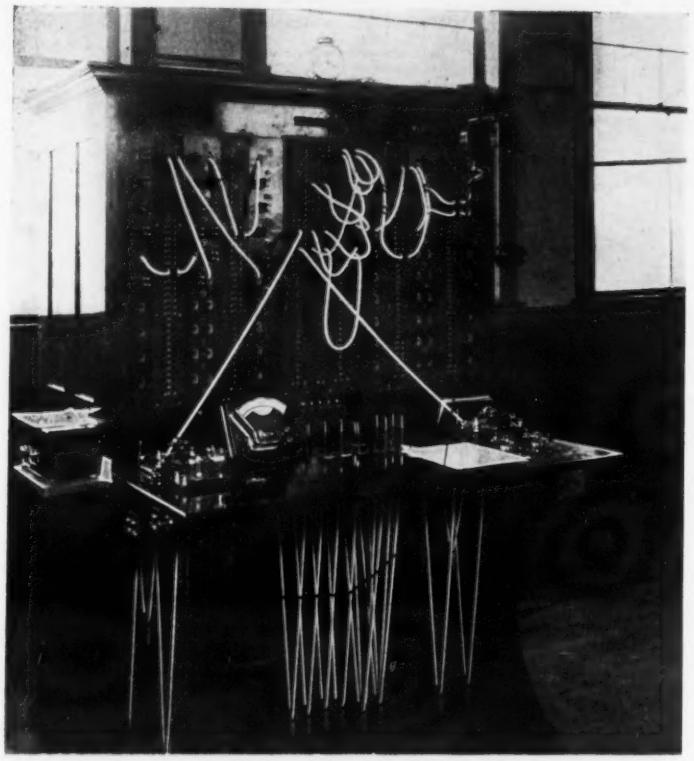


FIG. 24.—TEST PANEL, SHOWING METHOD OF BUILDING UP SIMULTANEOUS TELEPHONE AND TELEGRAPH CIRCUITS.

which the superintendent of that district is held responsible for the service of both telegraph and telephone equipment.

Fig. 15 is printed merely to indicate the density of toll line service operated by the various independent companies in Ohio, Indiana and Michigan. As a matter of fact, the network lacks many new lines. These lines are tributary to the United States Telephone Company's long-distance trunk lines. In the State of Ohio the United States Telephone Company now operate more than 19,000 miles of copper metallic circuit and is connected with 498 independent telephone exchanges, which operate more than 140,000 telephones and through the tributaries, such as various independent toll lines, reach 1,470 cities, villages, towns and hamlets in the State of Ohio. Fig. 16 is a map of the lines radiating from Columbus and illustrates how territories are mapped out for the various district superintendents.

A number of engravings are presented herewith, made from photographs in regard to features of the work. Fig. 17 is a view of the United States Telephone Company's repeater and switching station at Thompson's Corners, Ohio, and Fig. 18 of the repeater and switching station at Toledo, Ohio. Fig. 19 shows a terminal pole, with leads north, south and west. Fig. 20 illustrates the wire chief's room with repeater tables, test panel and a portion of the coil rack, Thompson's Corners. Fig. 21 shows a temporary test panel at Toledo, Ohio, and Fig. 22 shows the equipment used in small switching stations, in the wire chief's office of the local telephone company. Fig. 23 shows the cross-cennecting rack, Morse coils and bank of battery resistance lamps. Fig. 24 is a test panel and illustrates the method

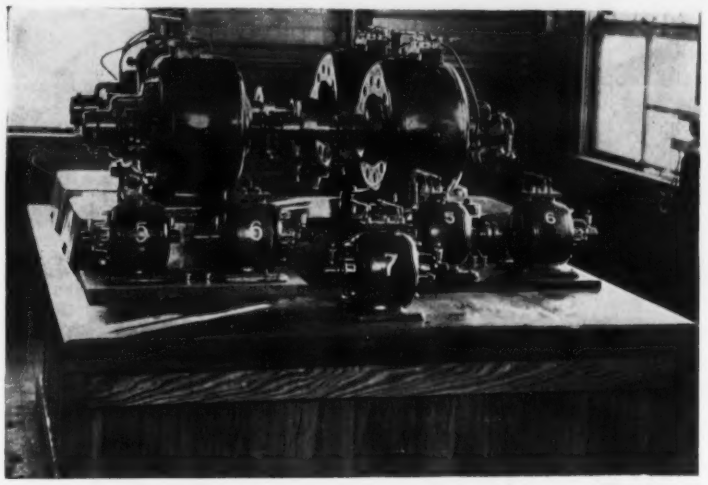


FIG. 25.—DUPLICATE SETS OF CHARGING AND RINGING MACHINES.

of building up simultaneous telegraph and telephone circuits. In Fig. 25 is seen an equipment of duplicate sets of charging and ringing machines. The generators are designed for charging storage batteries, for operating the systems as described above.

Within a short time the United States Telephone Company will be able to communicate with all the large cities of the central west, of the northwest, of the southwest and all the principal cities in the east except New York and Boston.

There is at the present time, with the exception of two breaks of 40 miles each, a solid copper metallic circuit of Nos. 8 and 10, from Topeka, Kan., to Atlantic City, connecting Topeka, Kansas City, St. Louis, Indianapolis, Columbus, Cleveland, Pittsburg, Baltimore and Philadelphia. Paralleling this, with the exception of two short breaks, is a solid copper metallic circuit connecting Albany, Syracuse, Buffalo, Cleveland, Toledo, Detroit and Grand Rapids.

With the building of less than 200 miles of line there will be a solid trunk line of copper metallic circuit connecting the northwest with the southwest, starting at Duluth, passing through Minneapolis and St. Paul, down the Mississippi River to La Crosse, Wis.; Dubuque, Iowa: St. Louis, Mo.; San Antonio and Galveston, Texas.

The Illinois Telegraph & Telephone Company is at the present time perfecting plans for joining the independent toll trunk lines of the central west with its large automatic exchange in Chicago. This will not only give switching facilities for the through trunk line systems, but will enable the independent telephone companies of the west to reach Chicago, which is their business center.

With the rapid consolidating of independent telephone properties that has been progressing for the past few years, we cannot but expect to see two great telephone companies competing for both telegraph and telephone business, which will eventually bring about a consolidation between one of the telephone companies and one of the telegraph companies. This may compel an alliance between the two remaining companies, for the telephone and telegraph companies combined can reduce operating expenses very materially. The same official staff, the same buildings, same conduit system, pole lines, etc., that is used by one can be used by the two; and many other decided economies could be effected and give a more effective and superior service.

Water Power Transmission Plant at Elliotts Falls, Ontario.

BY CHARLES L. FITCH.

THE Province of Ontario, situated as it is, immediately contiguous to the populous and agriculturally active States of New York, Pennsylvania and Ohio, would long since have rivalled them in wealth and importance were it not for the fact that its soil, with the exception of a strip along the southern border, is to a great extent rocky and barren, yielding at best but meagre return to the labor of the farmer. Nature, however, as if to make amends for its niggardness in this respect, has provided an abundant supply of water; and the surface is dotted with myriads of lakes connected by innumerable small streams, forming indeed an almost unbroken chain from Hudson Bay on the north to Lake Ontario on the south.

These streams as a rule are quite small, their average flow in many cases being less than 200 cu. ft. per second; but though the volume of water is not large, in most cases it is quite constant, owing to the immense natural reservoirs in the lakes above which constitute the sources of supply. For this reason they are admirably adapted to the development of power, as their even flow not only insures that the full amount of power counted on will be obtainable every day in the year, but does away with the expensive construction so necessary in less favored localities to take care of floods.

As it has become patent to all that the poverty of the soil in this region has rendered farming but a thankless occupation, increasing attention is daily being given to industrial enterprises as a means of livelihood, and although development must necessarily be slow, owing to the—as yet—limited resources of the people, it is not beyond the bounds of belief that we shall one day see the Province of Ontario prospering as a manufacturing district supplying the vast market which will then be found in the great agricultural Northwest, which even now shows signs of its coming importance. In this development, the many water powers along the small streams with which the country abounds, will play no unimportant part.

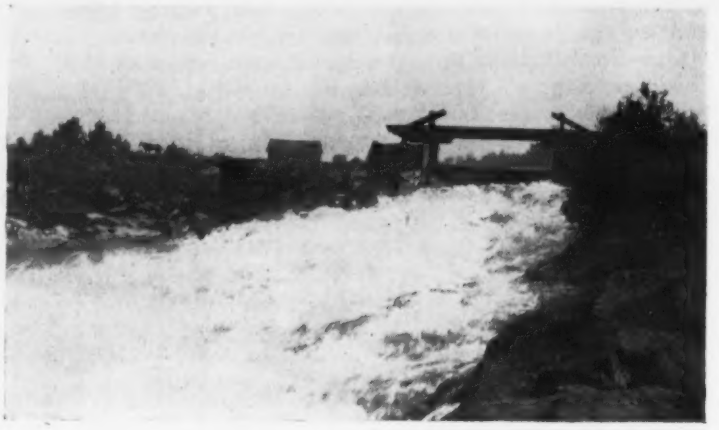


FIG. 3.—THE FALLS.

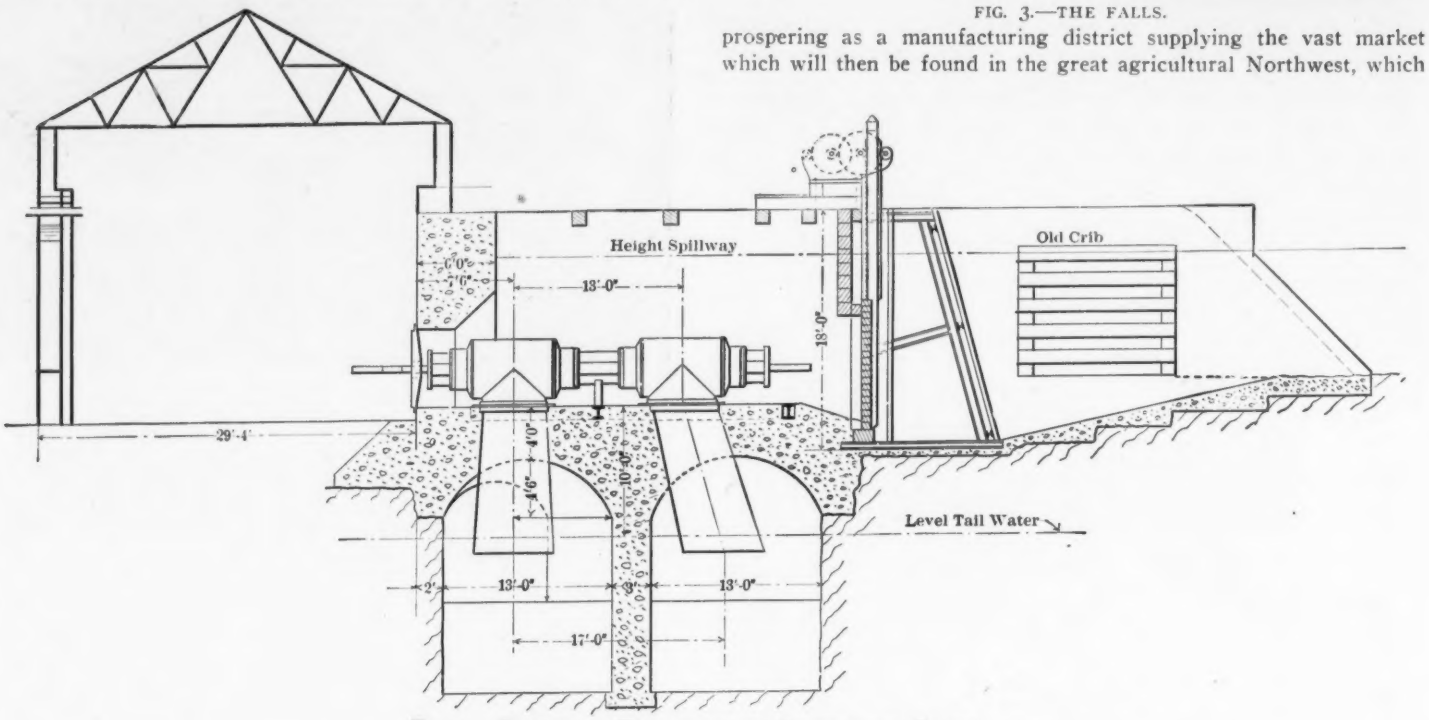


FIG. 1.—SECTIONAL ELEVATION OF GENERATING PLANT.

FIG. 2.—VIEW OF OLD DAM FROM BELOW.

Among the more recent enterprises set on foot in this section, not the least important is the cement works of the Raven Lake Portland Cement Company, a six-kiln plant of modern design located at Raven Lake, in Victoria County, about eighty miles north of Toronto on the Grand Trunk Railway. This manufactory, which will be ready for operation early in the coming summer, was designed by the well-known cement engineer, Robert F. Wentz, of Nazareth, Pa., and represents the most advanced ideas in the economic manufacture of cement. The marl forming one of the ingredients is to be dredged from the bottom of the lake, which covers a deposit of great depth, and the clay to make the mix will be brought in by rail from one of the near-by beds.

One of the most important considerations in an enterprise of this character is the power for operating the machinery and grinding the cement. This may be estimated at about 24 hp-hours per barrel of output; and when steam is used this item constitutes a very considerable factor in the cost of manufacture. Power for the Raven Lake enterprise will be obtained from Elliotts Falls, thirteen miles to the north, where a water power electric generating plant for the purpose is under construction; and it is with the development of power at this point that the present article will principally deal.

Elliotts Falls is on the Gull River, a small stream in one of the principal chains of lakes in this locality, which flowing south and east find their way eventually into Trent River and Lake Ontario. For many years the government has maintained a dam at this point, and a sluiceway to facilitate the "running" of logs, and the place was

once the site of a small mill, which, however, utilized but little of the power available. The flowage of the river when last measured was somewhat under 600 second-feet, and the fall from the spillway of the dam to the surface of tail water when operations were commenced was about 17 ft.

After careful consideration, it was decided to raise the dam 18 in., and by blasting out a ridge in the river below, lower the tail-water

FIG. 4.—EXCAVATING THE TAIL-RACE.

3 ft., giving a total head of 21½ ft. With these changes it was considered feasible to develop a maximum of 1,200 hp, and the work of designing the plant and supervising its construction was placed in the hands of the writer.

Referring to the sketch map at the beginning of this article, showing the falls and their immediate surroundings, it will be seen that the river flows in a southerly direction, and just below the falls, expands into a sort of basin or lagoon lying somewhat west of the general course of the stream. The government works, most of which have been utilized, consisted of a wood dam at the top of the falls proper, and a timber crib connecting with it, extending up and down the stream and confining the water to the easterly channel. The dam is provided with a sluiceway at each end and extensive runways for the passage of logs.

The plan of development included a tail-race and wheel-pit to be

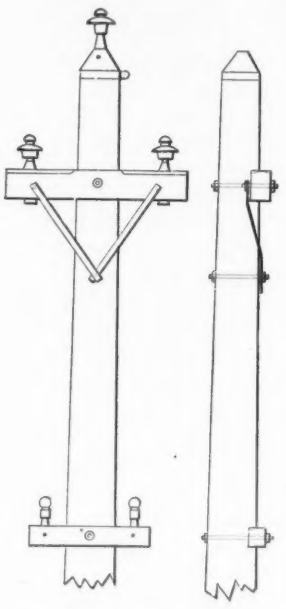


FIG. 5.—TRANSMISSION POLE.

blasted out of the solid granite rock formation just east of the crib referred to, and extending up from the lagoon below to a point about 50 ft. above the dam. This was then to be covered by arches of concrete masonry supporting the three wheel chambers, which were made to communicate with the river above the dam through the medium of a fore-bay, formed by removing a section of the crib and enclosing the space by concrete wing walls above and below. The dotted lines on the map show the relative location of the new work.

The south wing wall was deflected at a right angle and carried down stream about 35 ft. to form the west wall of the sluiceway at the west end of the main dam, thus making it feasible at any future time to remove the main dam and replace it with a concrete structure without interrupting the continuous operation of the plant. The north wing wall was extended out 15 ft. beyond the up-stream

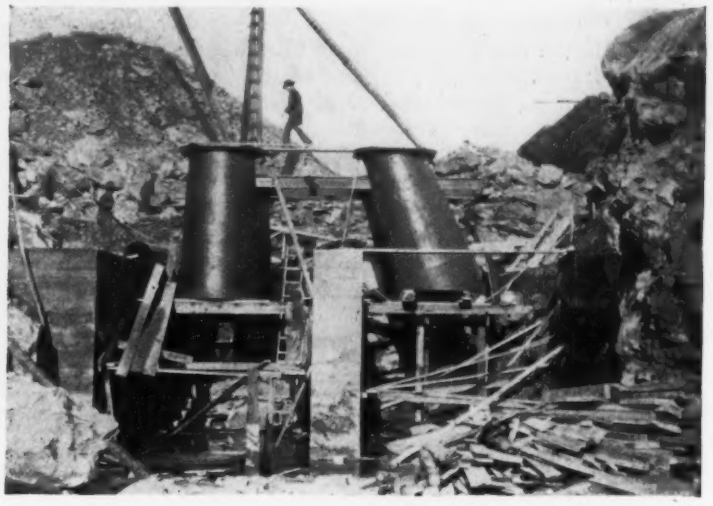


FIG. 6.—SETTING THE DRAFT TUBES.

face of the crib, which was heavily sheet-piled and reinforced by a puddle wall 3 ft. thick protected by a bank of gravel at a slope of one to one, riprapped with coarse broken stone.

As the main dam itself was very leaky, extensive repairs here were found necessary, but they will be only of a temporary nature, pending an entirely new structure in the near future.

In order to carry on the hydraulic work as above outlined, it was necessary to construct a coffer-dam from the west end of the spillway of the main dam to the west bank above the crib. The greatest depth of water found was about 7 ft., and the structure decided on was a cribwork of 10-in. x 12-in. hemlock sawed timber, 6 ft. wide on

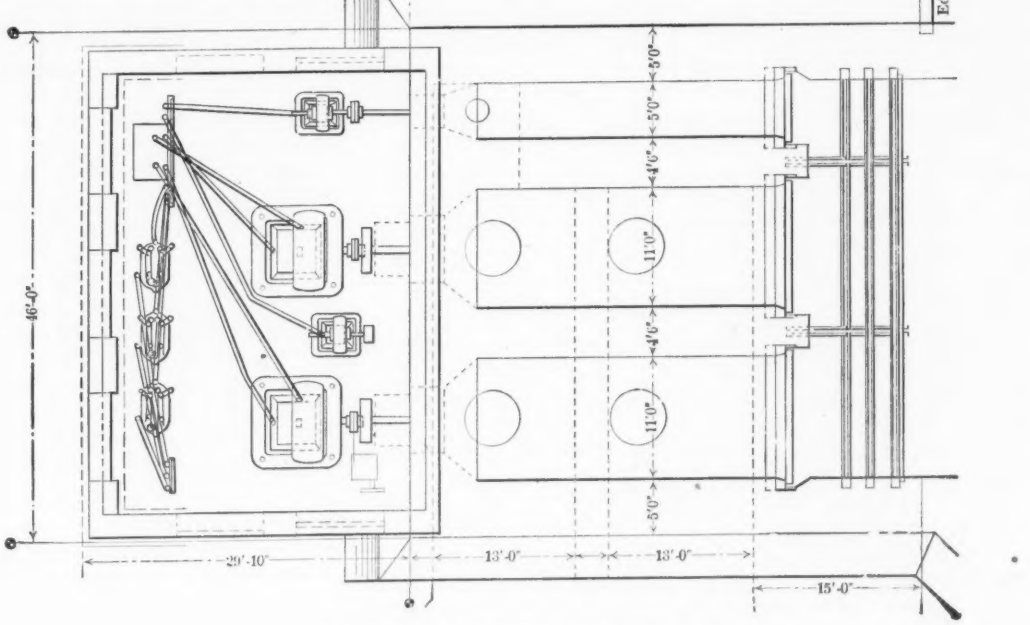


FIG. 7.—PLAN OF POWER HOUSE AND FOREBAY.

top, loaded with stone and sheet-piled with two layers of 1½-in. plank. This was found to answer the purpose satisfactorily.

The excavation of the wheel-pit and tail-race was carried on with rock drills of Canadian manufacture, the work being commenced at the north end and extended in a southerly direction toward the lagoon; the final breaking through into the river being deferred until everything was completed in the wheel-pits, and the draught-tubes and masonry supporting them were in place. The separating ridge

was then blasted out, letting the water in, the debris being removed by dredging. In this way the necessity of a coffer-dam below the falls was avoided.

The entire masonry structure was of concrete composed of Portland cement, sand and crushed stone in the proportions of 1, 2 and 5. The cement was of Canadian manufacture, and suitable sand and stone were obtained on the ground. The concrete was mixed by a Jeffrey spiral mixer.

As the necessity for early completion required that much of the masonry be put in place during the cold winter months, a temporary building framed of rough poles and sheathed with inch boards covered with tar paper was constructed over the entire work, and the interior was kept heated with stoves and steam coils to a temperature of not less than 40° F. day and night until completion. In this way the progress of the work was rendered independent of weather conditions.

The power house was constructed with concrete walls and a wood-sheathed felt roof supported on steel trusses. The general arrangement may be seen from the ground plan and section elevation shown herewith.

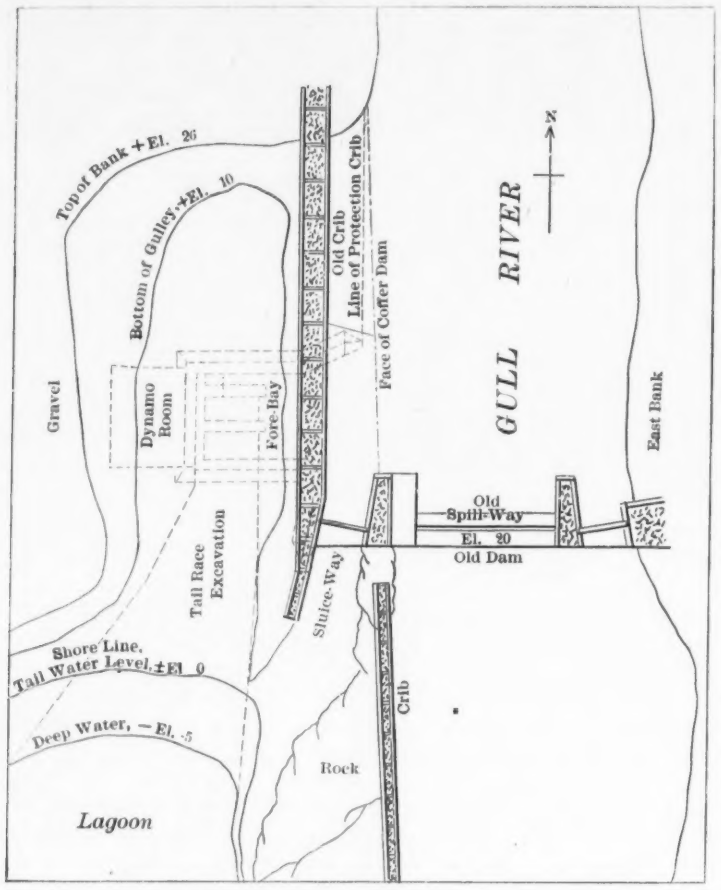


FIG. 8.—SKETCH MAP OF LOCATION.

The generating units, two in number, are each direct-driven by a bank of four 25-in. horizontal turbine wheels mounted on one shaft, which pierces the breast wall separating the wheel chambers from the dynamo room.

The turbines were furnished by the Jencks Machine Company, of Sherbrooke, Ontario, and each bank of four has an ultimate capacity at full head, of 600 hp on the wheel shaft. They are equipped with Woodward governors.

The generators have each a rated capacity of 350 kw and generate alternating current of 25 cycles. There are two exciters, each sufficient for the entire output of the station. One of them is designed to be belt-driven from the shaft of either of the main dynamos, while the other is provided with its own pair of turbines and is direct-driven.

The low-tension switchboard is of marble and is located at the north end of the building. It consists of a main panel, two generator panels, an exciter panel and a feeder panel, all equipped with the usual instruments and switches. The high-tension switchboard is of similar material and is placed at the south end of the room, the space between the two being occupied by the static transformers, which step the current up to 16,000 volts for transmission to Raven Lake. All wiring is carried in conduits placed beneath the concrete floor, and the station is protected by lightning arresters of the General Electric type. The entire electrical equipment was furnished by the Canadian General Electric Company.

The transmission line, between the generating station and the cement mill at Raven Lake, is supported on cedar poles, spaced 115 ft. apart. The general arrangement may be seen from Fig. —, representing a trimmed pole. Each pole has a single cross arm 4 in. x 6 in. of Georgia pine, with steel braces and Locke porcelain insulators. The conductors, three in number, of No. 2 aluminum cable, are carried, two on the cross arm and one on the peak, forming an equilateral triangle, 28 in. on a side. There is also a telephone circuit of two No. 12 galvanized iron wires, supported on a smaller cross arm placed 6 ft. below and transposed every 500 ft. Both the cross arms and the braces are bolted through the poles with galvanized bolts.

The poles vary in length from 30 ft. to 45 ft., being set to a profile, avoiding all abrupt changes in level; and the line runs partly along the public highways and partly over private property, keeping it as straight as possible.

At the Raven Lake end there is a masonry sub-station 25 ft. x 37 ft., in which are placed the static transformers which step the current down to 600 volts for use in the mill.

In this connection, it is interesting to note the strides forward which mark the present era in the history of our cousins across the border; and the case in point, where almost everything needed was obtained from native sources, is but a slight indication of the growth which has taken place in the last decade.

The Canadian is nothing if not conservative, and turns his back squarely on the bubble of inflation. Born of a self-reliant stock, he thinks well of his own judgment, but does not disdain the assistance of others. While making haste slowly, his progress is exceeding sure, and unmarred by the fiascos which have brought many to ruin. With a supreme confidence in the good-will of his fellow-men, he takes kindly to a new idea only when he has become satisfied that it will pay, but once satisfied he embraces it eagerly, subscribes to it as far as his means will permit, and works with a will to help it along. For these reasons his banks are secure and his shares generally pay dividends.

The Raven Lake Portland Cement Company is a Canadian institution having its headquarters at Toronto. John Lucas is its president and Thomas McLaughlin its secretary-treasurer, and to the untiring energy and devotion of these gentlemen may largely be traced the success which has attended the launching of this enterprise.

Cable War Messages.

A telegram to the newspaper press from Chicago of March 21 says: "Two Associated Press war bulletins raced from Yin-Kow to Chicago to-day, one by the European route and the other across the Pacific. The one from the east reached here at 11.12 o'clock, and the one from the west just eight minutes later. Both were filed at Yin-Kow to-day at 7.30 P.M. Each was about 100 words in length, and they were almost identical in matter. They were sent by different routes to test the rapidity of transmission. They were not censored or held up in any way en route." In this connection the *Chronicle*, of San Francisco, asserts that that city is now the center for the world of news from the Pacific.

N. E. L. A. Index.

A very comprehensive and much needed index of all the volumes of proceedings of the National Electric Light Association since its first convention is now in process of compilation. This work has been undertaken by Mr. T. H. Creden, who is not only one of the best statisticians in the electric lighting business, but is also a constructing and operating electrical engineer, having served in both capacities with the Chicago Edison Company and with Messrs. Stone and Webster. In giving his services for this work, Mr. Creden will deserve much gratitude from the members of the Association and others interested in the reports, as it now becomes an easy matter to find at once any topic or paper to which reference is desired. Until the book of the twenty-sixth convention was printed no attempt at a topical index has been made. It is the intention to have the complete index printed before the Boston meeting, to be held May 24, 25 and 26.

Electricity and the Law in England and America.

By W. Valentine Ball, Barrister-at-Law.

THERE is no subject which awakes a wider interest on both sides of the Atlantic than electricity. The extraordinary development of its varied uses in recent years, the facilities which it has afforded for locomotion and the transmission of messages, not to mention all the other multifarious needs of mankind which it serves, tend to give it the foremost place among those branches of modern science, which have been found capable of practical application.

Seeing that the application of electricity on a commercial scale is of comparatively recent growth, it is not surprising that the law which affects its generation and distribution is to be found in statutes passed and cases decided within the last few years. But the search, even when conducted by a lawyer in England, should not be confined to English statutes and law reports. If exhaustive treatment is required or an argument is to be pointed by references to a decided case, he must often refer to the work of American lawyers, for numerous interesting cases upon the laws of electricity have from time to time been decided in the courts of the various States of the Union.

It is to be observed, however, at the outset, that although English and American lawyers have advanced along the same lines in ascertaining the application of legal principles to the vagaries of electricity, the decisions in the one country can only be regarded as useful precedents by lawyers in the other. Further, the decisions in the various States of the Union are by no means uniform, nor does it appear that the opinion of a judge in one State is binding upon that of his judicial brother in another State. Nevertheless, the general principles—with which it is my object to deal in the present article, may, broadly speaking, be taken to apply not only in England and America, but throughout the countries which are inhabited by English-speaking races.

In England, the manufacture and supply of electricity to consumers is an industry in which any private person may indulge without legal restriction, so long as he complies with the ordinary law relating to nuisance and negligence. In view, however, of the difficulties attendant upon the laying of wires and mains across private and public property, and the necessity of allowing electrical companies to have power to break up roads, etc., for this purpose, certain acts have been passed under the provisions of which the supply may be carried out under powers which impose upon each company the duty of supplying every consumer in its district on equal terms. Of these, an act passed in 1882, is the most important, and one of its provisions is worthy of particular attention, *e. g.*, Section 17, which provides that in the exercise of the powers in relation to the execution of works given them under the act, or any license, order or special act, the undertakers shall cause as little detriment and inconvenience and do as little damage as may be, and shall make full compensation to all bodies and persons interested for all damage sustained by them by reason or in consequence of the exercise of such powers, the amount and application of such compensation in case of difference to be determined by arbitration. This clause makes it plain that the company cannot plead their parliamentary powers in answer to an action for damage caused by them in the execution of their works.

Their liabilities are further declared by another provision which forms part and parcel of every order under which they work, and which provides that nothing shall exonerate electric lighting undertakers from any indictment, action or other proceedings for nuisance in the event of any nuisance being caused by them.

The effect of these sections is that they are subject to what is known in England as the common law. There is nothing which better illustrates the adaptibility of the English law to the needs of the public than the way in which the legal questions incidental to the supply of electricity are found to be solved in so far as they are not dealt with in special statutes by the recognized principles underlying the leading cases decided by English judges in days gone by

It is proposed to deal here with the liabilities of supply companies under the heads of (1) negligence and (2) nuisance.

There are many ways in which a supply company may be guilty of negligence. At the generating station itself perpetual care has to be taken that the apparatus is in such order that employees shall not be exposed to unnecessary risk. Heavy machinery involves danger to those who are employed to work it, while men employed around dynamos and at a switchboard are constantly exposed to the risk of electric shocks. Accidents at generating stations give rise to claims for compensation under the Workmen's Compensation Act, 1897, and the other acts which render employers liable to pay damages for injuries which are caused by their negligence in permitting the use of defective machinery, or employing persons whose negligence occasions injury to their fellow servants. As questions of this kind are of common occurrence and are determined upon principles which apply to all actions for personal injuries, it is not necessary for our present purpose to discuss them further.

I pass on to consider the question of liability for accidents which may arise during the transmission of electricity. Dealing first with electric lighting companies, it is necessary to point out that for the purpose of their undertaking they usually require to lay their lines overhead or underground along public streets. The Electric Lighting Acts, subject to any special modifications which may be introduced in favor of any particular company, confer upon the undertakers the right to exercise the power, subject to their making compensation for any damage or injury which they may occasion to any property interfered with. In the case of overhead wires, attachments may have to be made to houses or private property along the roadway, or to posts erected on the street itself. Again, when wires are laid underground, it is often necessary for the lighting company who wish to lay their wires to remove temporarily water pipes or gas pipes which may be in the way. In all these cases the company is liable for negligence.

But the liability of the company does not end with construction of works. They are also bound to make good any damage which may be occasioned to the public by falling wires, escape of current and electric shock. If we may refer to a case which has to do with electric traction, in a case which was heard some years ago, it was proved that a wire which was fully charged, fell upon and killed a horse. The Court held the company liable. But where, in another case, the damage was caused by a telephone wire falling on a trolley wire and so earthing the return current, it was held that inasmuch as the falling of the telephone wire was the proximate cause of the accident, the electric supply company was not liable. It was held in that case that the injury was really caused by the negligence of the telephone company in allowing its wire to get into such a state of repair that it broke and fell. It follows from this that if a wire were to break and do damage to private property of any kind, the electrical company might be held responsible.

No liability, however, will be incurred in respect of damage which results from an act specially authorized by statute, or which is the necessary consequence of what is so authorized; but for this exception to apply, the power specified by the statute must be strictly adhered to, and if a choice exists as to the manner in which the powers may be exercised, due regard must be had to the individuals or the public affected by the exercise of the powers.[1] Hence if we may again borrow an illustration from the law relating to tramways, if a company has authority to conduct electricity along naked wires or rails, it will not generally be liable for any injury to a person coming into contact with them, nor will it be liable for any injury caused by the accidental breaking of a wire or rail merely by reason of such breakage. Where there is negligence on the part of the company, however —as if wires are allowed to sag so as to be within reach of persons passing along the street—the company will be liable for injuries arising out of such negligence, and in such cases the burden of proving negligence is not on the person claiming damages. In a case from Cape Colony[2] the defendants were owners of a telegraph wire and poles, which they had erected along a street under proper authority. A boy passing along the street either touched accidentally or took hold of a wire hanging from a pole, and his right hand was seriously injured by the electric current. It was given in evidence that the day before the accident the wire was hanging slack within the reach of passers-by, and this had been duly reported by a lineman to his superiors, and that the wires were usually inspected every four days. The company was held responsible. It was urged on behalf of the company that the plaintiff had been guilty of contributory negligence, but the Court held that there was a distinction to be observed between contributory negligence in a child and in a man.

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[1] Seward Brice on Tramways, 1902.

[2] *Kift v. Town Council of Cape Town*, 1 South African L. J. (1901) 181.

Cases of negligence decided in the American and Canadian Courts are exceedingly useful to English lawyers. The effect of these cases is admirably stated in Mr. Robertson's work on "Tramways and Light Railways," 1903, p. 240. Thus, with regard to the care required from owners of electric apparatus, it has been decided that such care should be in proportion to the dangers which it is their duty to avoid, although, as was decided in the case of Perham v. Portland General Electric Company,[3] they are not bound to have perfect apparatus or construction. In another case it was held that a company who have wires and poles in the streets are bound to maintain such poles properly, but are not liable for subsequent defects which inspection would not reveal.[4]

In placing a pole near existing electric apparatus they are bound to take due measures to avoid contact, and to inspect from time to time, in order to keep their apparatus in suitable condition with reference to the previously existing apparatus. Mr. Robertson also deduces the following statement of law from American cases: "Generally, the grant of the privilege to encumber the highway with dangerous electric apparatus imposes a duty not to injure persons lawfully on the highway, and to make the highway substantially as safe for them as it was before, and also to consider the safety of persons, such as workmen, whose employment will naturally bring them into proximity with such apparatus. A storm, which is the immediate cause of the accident, is no excuse where there is such a want of care, but it may be, where there has been reasonable care, and the storm is an extraordinary one."

The case of Royal Electric Company v. Heir (21 *Can. Law Times*, 442, 1901), which was decided by the Court of Appeal of Quebec, well illustrates the obligation of a company contracting to supply electricity. In this case the plaintiff claimed damages for the death of her husband (to whose house the defendant company supplied electricity for lighting purposes) caused by his taking hold of an electric lamp (supplied by the defendant company in the ordinary course of their business) with the intention of turning on the light. The precise cause of the accident was not proved, but it was suggested by the Company that it was due to contact between the wire supplied by them with a guy wire of another company's system. Damages were awarded to the plaintiff and an appeal by the company was dismissed, the Court holding that there was negligence on the part of the company, and that the burden of proof of the fact, act or omission constituting negligence was not on the plaintiff.

The cases above referred to are drawn without discrimination from American, English and Colonial Law Reports, as so far as the law of negligence is concerned the judiciary of both countries appears to rely upon similar principles.

With regard to nuisances, it is important to again refer to the provisions of Section 17. It provides, as we have seen, that the undertakers are to do as little damage as may be. It follows that if and in so far as they do more damage than is necessary, or use a process which is (1) not the best known process, or (2) an unapproved process, they are, to that extent, common tort feasors, and amenable to the ordinary law, as well as to any statutory penalties and liabilities which may be imposed.

In dealing with the legal liability for nuisance much that has been said with regard to negligence has to be carefully borne in mind. A nuisance, however, may be created as incidental to the manufacture and supply of electricity. In these circumstances how far is the supply company to be held responsible? In the English case of *The National Telephone Company v. Baker*[5] a tramway was worked on the overhead trolley system. The current, after traversing the trolley wire and the car, returned by the rails and an uninsulated copper conductor running under the roadway parallel to the rails and connected with each rail. The telephones of the plaintiff company were worked on the single wire system with an earth return. The consequence was that the telephones were rendered practically useless, and the company claimed an injunction to restrain the defndant from using tramways so as to be a nuisance to or interfere with their telephones. The Judge who tried the case was inclined to decide in favor of the telephone company, but was prevented from doing so by the fact that the tramway company were protected from actions of this kind by their private act. In coming to the conclusion that the tramway company would have been liable if not so protected, he was guided by the decision in the famous case of *Fletcher v. Rylands*, where it was held that "The person who for his own purposes brings on to his land and keeps there anything likely to do mischief, if it escapes, must keep it at his peril, and, if he does not do so is *prima facie* answerable for all the damage which is the natural consequence of its escape. He can excuse himself by showing that the escape was due to the plaintiff's default; or perhaps that the escape was the consequence of *vis major*, or the act of God."

It is somewhat doubtful whether this principle can be properly applied to the use of electricity. If a man who makes use of delicate electrical apparatus were entitled to prevent a tramway or electric lighting company from doing anything which may affect his instruments, the progress of electricity in its application to great undertakings would be wholly arrested. The doctrine of *Fletcher v. Rylands* protects a man in the natural use of his property, and it cannot be said that the employment of delicate instruments is a natural use. Of course, the provisions of a particular tramway act may deprive him of his remedy; but it is submitted that wholly independent of statute law a telephone or telegraph company could not succeed.

A recent case in the Privy Council, which came before that august tribunal on appeal from the High Court of Cape Colony would seem to support the view that *Fletcher v. Rylands* must not be pressed too far in connection with electricity. In that case an action was brought by a telegraph company against a tramway company for interference by induction. In deciding for the tramway company, Lord Robertson said: "The appellants cannot claim higher privileges than other owners of land, and cannot create for themselves, by reason of the peculiarity of their trade apparatus, a higher right to limit the operations of their neighbors than belongs to ordinary owners of land who do not trade with telegraph cables." It is true that this decision was based not upon English law but upon Cape Dutch law; but it is important to notice that the sound principle which underlies it has long been adopted in the United States. In the case of *Cumberland Telephone and Telegraph Company v. United Electric Railway Company*[6] it was held that a telephone company could not restrain an electric railway company where the escape of electricity from the wires of the railway company was incidental to the conduct of their business, and where the telephone company could protect itself at much less expense than would be incurred by the railway company in preventing the escape of electricity. It may therefore be assumed that in future English judges will administer the law as it has been laid down in the Capetown Tramway case.

Further, the principle there laid down is consistent with what is usually recognized as a correct statement of the law of nuisance in England. Thus, Mr. Garrett, in his work on the law of nuisances, states: "If the owner of land uses it for any purpose which from its character may be called non-natural user, such, as for example, the introduction on to the land of something which in the natural condition of the land is not upon it, he does so at his peril, and is liable if sensible damage results to his neighbor's land, or if the latter's legitimate enjoyment of his land is thereby materially curtailed."

It might also be mentioned that a telephone company cannot claim any monopoly in the use of the earth for the purposes of return currents. At least the law has been so decided in a number of American cases that a telephone company has no vested interest in or exclusive right to the use of the "ground circuit" or "earth return" as against an electric street railway authorized by statute.[7]

Thawing Out Pipes.

Writing us on the subject of frozen water pipes, Mr. W. M. Bell, of the Conshohocken Electric Light & Power Company, of Conshohocken, Pa., says: "I beg to inform you that we have thawed out frozen service pipes and water mains by electric current, using a 10-kw transformer and taking from 75 to 160 amp. at 110 volts and not failing to start water running in from 3 to 45 minutes. The service water pipes are, as a rule, ½-in., ¾-in. and 1-in. pipe; also ½-in. lead pipes, and the mains thawed out were 1½-in., 2-in. and 2½-in., thawing at one time 2½-in. pipe about 450 ft. long in 45 minutes. This has been done in every instance without digging, connections being made at house of owner or on fire plug. We charge $5 a service, and have found it very profitable work. This work was carried out under my supervision, as superintendent of the company, and is the first done in this section."

[3] (1898) 33 Or. 451.
[4] City of Denver v. Sherett, (1898) U. S. C. C., Colo.
[5] (1893) 2 Ch. 186.
[6] (1890) U. S. C. C., Tenn.
[7] (*Cincinnati Inclined Plane Railway Company v. City and Suburban Telegraph Association*, 48 Ohio State Rep., 390.)

The Shielded Balance.

BY G. A. CAMPBELL.

EXPERIENCE shows that an ordinary balance when employed with an alternating current of the order of 2,000 cycles per second is variable and indefinite. It is the purpose of this article to show how this source of error may be entirely eliminated by shielding.

The difficulty encountered lies mainly in the direct capacity between the different parts of the system. Since the ether permits the flow of alternating currents in all directions, the attempt to employ an ordinary balance for alternating measurements is much the same as the attempt to measure resistance with a Wheatstone bridge immersed in a conducting fluid, such as acidulated water. In general a movement of the observer will change the distribution of the capacity effect and will change the adjustment required for a balance. Since it is necessary that the observer make certain movements in order to adjust the apparatus for a balance, this is a serious difficulty. Again, the entire generator circuit and connections form a part of the system, and any change in their capacity or leakage may affect the adjustment required for a balance. In case the generator is run from a lighting circuit, there is, of course, a direct capacity from the alternating-current side of the generator circuit to the lighting circuit, and this introduces the entire lighting system into the balance.

Even although the capacity of the entire system were kept invariable, there would be the difficulty that its distribution could not be determined. Thus, there may be direct capacity bridged between any number of points of the balance. This is illustrated in Fig. 1, where condensers are drawn in to illustrate this effect. Ex-

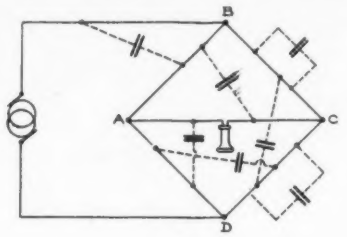


FIG. 1.

perience has shown and theory confirmed the fact that, with telephonic frequencies and impedances, these capacities are sufficient to cause large errors in the balance measurements.

As an example, take a balance having ratio arms of 1,000 ohms each, coils of .25 henry and 10 ohms effective resistance in the other arms and a frequency of 1,592 cycles per second, making $p = 10{,}000$. Then 100 micro-microfarads shunted around one ratio arm will introduce an error of 2.5 ohms, i. e., 25 per cent. in the effective resistance of the coil. The error varies as the square of the frequency and thus amounts to 100 per cent. at a frequency of 3184 cycles per second.

It is impracticable to isolate the different parts of the balance sufficiently to reduce these capacities to a negligible amount. The only practical way is to shield the different parts of the balance from each other and from any outside sources of disturbance.

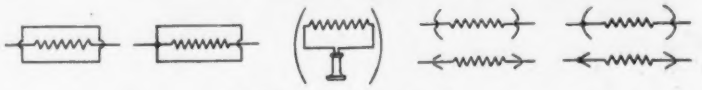
Shields may be divided into three classes, namely, 1°, magnetic; 2°, leakage, and 3°, capacity.

Magnetic shields are most advantageously made of thick iron castings. For alternating-current work they may also be made of masses of any conducting material, but iron seems to be the most efficient, considering its low cost and high permeability. In any case an efficient magnetic shield requires a large amount of material. Fortunately, the greater part of the apparatus does not require magnetic shielding. In resistances and condensers the magnetic field is very weak, and by winding inductance coils and transformers in toroidal form their external field can be made quite small. In the case of such inductance standards as have a large stray field, it is undesirable to introduce a magnetic shield on account of the difficulty of avoiding dissipative losses. Such standards must be put at a distance from other apparatus so as to avoid mutual disturbance. It is my expectation that inductance standards can be made toroidal in the future, so that the apparatus for standard alternating-current work can be used without magnetic shielding.

Leakage and capacity shields must ordinarily surround one of the two systems to be mutually shielded. Since it is usually a comparatively small capacity and leakage which is to be cut off by the shield, it is not necessary that the shields should have a small impedance. They may thus be as thin as is convenient to handle, and of any conducting material. While it is not necessary to keep the resistance of the shield small, it is desirable that the shield be so arranged that the flow of current in it shall be as direct as possible. In case the shield were spiral enclosing an iron core, the inductance of the shield circuit might be sufficient to make trouble, even although the resistance was negligible.

Fig. 2 shows diagrammatically a resistance coil with a shield entirely surrounding the coil, with the exception of two terminals. This shield is not connected to the coil and may be called a *floating* shield. Fig. 3 shows the same arrangement with the shield connected directly to one of the terminals of the resistance. This may be called a *connected* shield.

In case these shields have capacity to any other part of the system, it is evident that, with the connected shield, this capacity is



FIGS. 2, 3, 4, 5 AND 6.

definitely localized and terminates on one terminal of the resistance. It is also evident that, in the case of the floating shield, the capacity is not in general localized on any one part of the resistance, for the current to the shield will divide and a part will reach every part of the resistance which is exposed to the floating shield. In general, a floating shield is of use only when it entirely surrounds a system or a portion of a system connected only by mutual inductance with the remainder of the system. In other cases a connected shield is necessary if it is to shield one portion of a system from another portion of a system.

It is convenient to adopt a symbol for shields, since it is confusing to indicate them upon a diagram in case they form an extensive system. Figs. 4 and 6 show a symbol which I would suggest, the idea being that parentheses enclosing a network or any portion of a network represent a shield surrounding that much of the network. In case the terminals project through the shield they are shown projecting through the parentheses. In case the shield is short-circuited to one of the terminals of the network that is shown by a dot connecting the proper parenthesis with the terminal. It is to be understood that the parentheses are electrically connected. The parenthesis may degenerate into an arrow head for convenience. When several shields are employed, brackets, braces and quotation marks may be introduced. By designating shields by letters, as *S*, *S'*, *S''*, . . . their connection may be shown in the same conventional way as a ground connection. See Figs. 7 and 13.

Fig. 7 shows a shielded balance. Each of the six branches has its individual shield, which is connected to one of its terminals, and

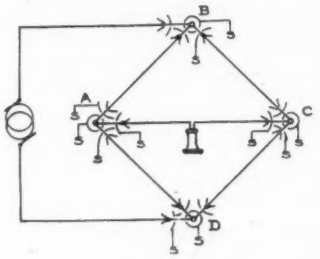


FIG. 7.

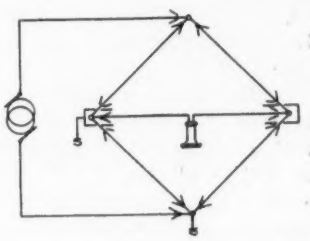


FIG. 8.

the entire balance is surrounded by a shield which is shown floating. The six terminals to which the six individual shields are connected may be disposed with respect to the four corners of the bridge in any one of the possible ways. To each of the four corners individual shields may be connected or one of the corners may have no individual shield connected to it, as shown in Fig. 7, corner *C*. The floating shield may be directly connected to any one of the four corners of the bridge. If the connection were made to a corner, such as *D*, where three of the individual shields terminate, as is shown in Fig. 7, then a material reduction in the complexity of the system would result, for three of the branches would be reduced to a single shield, and only the remaining three branches would have a double shield. In fact, but one double shield would be absolutely necessary, for, if the telephone circuit has a double shield, it does not make any material difference whether a leakage or capacity is

shunted from terminal B to terminal D, provided it is not so large as to introduce serious shunting and does not contain an alternating e.m.f. and is not fluctuating rapidly itself. This arrangement is shown in Fig. 8.

Returning to Fig. 7, if the capacities of the corners to the floating shield are C_A, C_B, C_C, C_D, as shown in Fig. 9, then the equivalent set of direct capacities, C_1, C_2, C_3, C_4, between the bridge corners is:

$$C_1 = C_A C_B / (C_A + C_B + C_C + C_D)$$
$$C_2 = C_B C_C / (C_A + C_B + C_C + C_D)$$
$$C_3 = C_C C_D / (C_A + C_B + C_C + C_D)$$
$$C_4 = C_D C_A / (C_A + C_B + C_C + C_D)$$

If the impedances inserted directly between the corners are Z_1, Z_2, Z_3, Z_4, the condition for a balance is:

$$\frac{Z_1}{1 + Z_1 C_1 pi} \cdot \frac{Z_3}{1 + Z_3 C_3 pi} = \frac{Z_2}{1 + Z_2 C_2 pi} \cdot \frac{Z_4}{1 + Z_4 C_4 pi}$$

This makes the balance perfectly definite. The formulæ show that there is an advantage in leaving the outside shield floating, as this reduces the effect of any slight error in the determination of the capacity of the bridge corners to the floating shield.

In case an adjusting condenser is provided, the capacity to the floating shield may be so proportioned as to be eliminated in the equation for a balance. Thus: If Z_1, Z_2 are the bridge arms which are to be kept constant during a series of measurements, by making $C_A / C_C = Z_2/Z_1$, this condition is fulfilled. This may always be accomplished by adding a capacity at A or C, as the case may be, and balancing with Z_3 and Z_4 removed. It is, of course, necessary to consider the conductances as well as the capacity, and to balance this requires an adjustable leakage. Of course, the same balancing and elimination of the capacity may be carried out if the shield, S, is connected to the corner, D, which is necessary in a large class of work.

It is evident that there is in the preceding no limitation to equality ratios. Inequality ratios may be employed, and in fact the two ratio arms need not be of the same character. For instance, one might be resistance while the other was capacity.

Expressed in terms of the four admittances, Y_1, Y_2, Y_3, Y_4, directly connecting the four corners of the balance and the four admittances, Y_A, Y_B, Y_C, Y_D, directly connecting the four corners of the balance with the shield, S, the general condition for a balance is:

$$\left(Y_1 + \frac{Y_A, Y_B}{Y_A + Y_B + Y_C + Y_D}\right)\left(Y_3 + \frac{Y_C\ Y_D}{Y_A + Y_B + Y_C + Y_D}\right)$$
$$= \left(Y_2 + \frac{Y_B\ Y_C}{Y_A + Y_B + Y_C + Y_D}\right)\left(Y_4 + \frac{Y_D\ Y_A}{Y_A + Y_B + Y_C + Y_D}\right)$$

If none of the eight admittances vanish or are infinite, a balance might be obtained by suitably adjusting any one of the eight.

In case the admittance of corner B to the shield is equal to zero, the ratio of the balance will be equal to Y_2/Y_1, irrespective of the other admittances to the shield, S.

In case $Y_C / Y_A = Y_2/Y_1$, the ratio of the balance will be independent of the admittances of corners B and D to the shield S.

In case either pair of diagonally opposite corners is shielded from S, the balance is independent of the capacity of the two remaining corners to the outside shield, S.

In case $Y_B = 0$, and $Y_D = Y_A + Y_C$, the potential of the shields when a balance is obtained will be half-way between the common potential of C and A and the potential of D.

The shielded balance shown in Fig. 7 has a double shield entirely surrounding the generator system and another double shield entirely surrounding the telephone circuit, telephone and observer. One or the other of these shields may, as explained above, be reduced to a single shield. Even as thus simplified, however, the arrangement is not in general convenient. It is not practicable to shield a generator which is connected directly to a lighting plant, and it is not convenient to shield an observer. In order to avoid these difficulties, we may introduce transformers into both the generator circuit

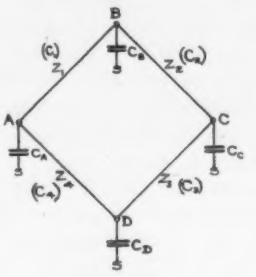


FIG. 9.

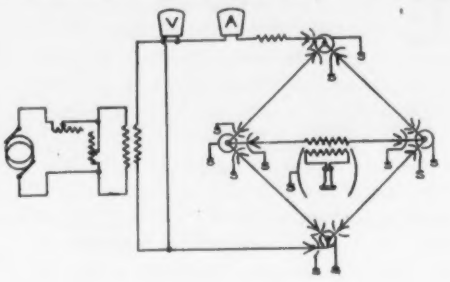


FIG. 10.

and the telephone circuit. Fig. 10 shows an arrangement of shielded balance with two transformers. This balance leaves the generator, generator circuit and observer entirely unshielded, and is a perfectly practicable arrangement. Any change whatever in the generator circuit or the generator circuit transformer can have no effect upon the integrity of the balance so long as the shielding remains

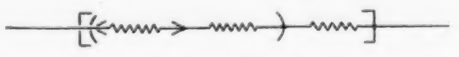
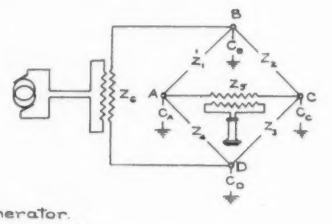


FIG. 11.

perfect. Thus, the generator may become grounded to the outside shield, either side of the repeating coil may become short-circuited to the shield surrounding it, or any number of convolutions may become short-circuited. These changes may affect the efficiency of the generator circuit, but can in no way introduce an error into the balance. The same is true of the telephone circuit. So long as the telephone is shielded as shown, any changes in itself or in its transformer will affect only its efficiency. It cannot introduce a false balance. Furthermore, the observer may change his position and his capacity and leakage to the outside shield and to the generator and generator circuit without in any way affecting the integrity of the balance.

Fig. 10 shows, in addition to the balance, the rheostats for varying the e.m.f., and the voltmeter and ammeter for measuring the current employed, all properly shielded. This shielding precludes any disturbance of the balance.

In case two impedances are to be placed in series in any branch of the balance, each may have its individual shield connected to one of the bridge corners. See Fig. 12, where the inductometer and resistances are arranged in this way.



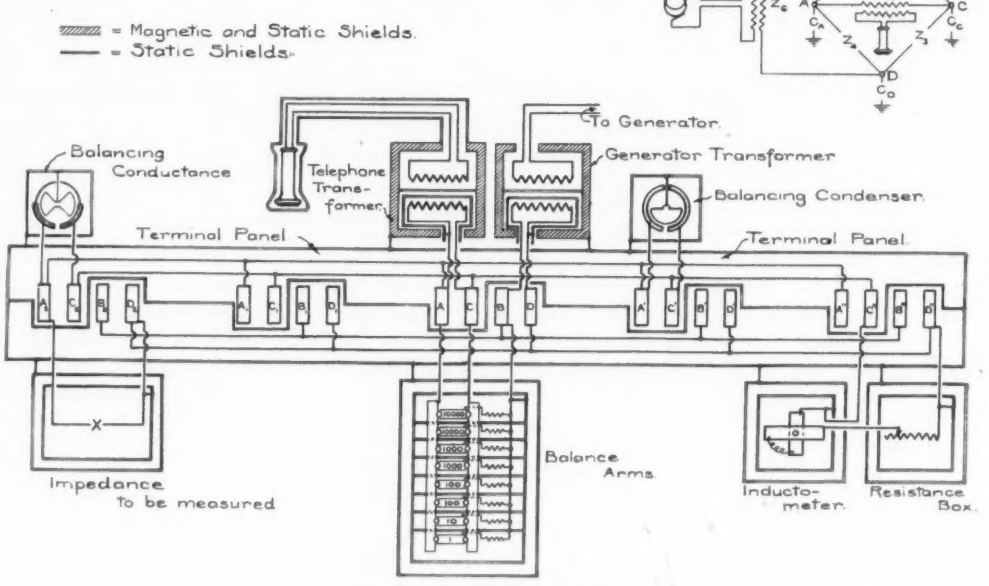
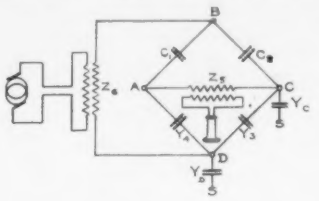


FIG. 12.—DIAGRAM OF SHIELDED BALANCE.

In case three impedances are to be connected in series, at least three courses are open. We may measure the capacity of the individual shields to the general shield and allow the proper correction.

We may so adjust the capacities, C_A, C_B, C_C, C_D, as to make the potential of the outer shield the same as that of the third shield. In general this would necessitate the use of considerable conductance and possibly inductance. Finally, we may shield the third shield by enclosing it within one of the others, and allow for the capacity thus directly shunted around one of the impedances. This use of shields within shields seems to be of considerable practical importance, and will be taken up again in connection with resistances and with switches. It is illustrated in Figs. 11 and 13.

Figs. 12 and 13 show more in detail two arrangements



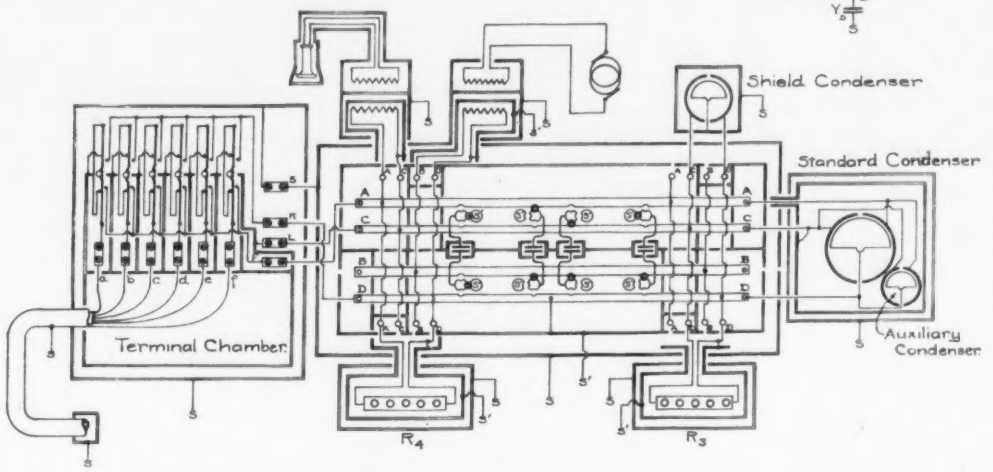


FIG. 13.—DIAGRAM OF SHIELDED BALANCE.

for shielded balances. Fig. 12 is arranged for inductance measurements and Fig. 13 for capacity measurements, but either may be employed for both measurements. Each arrangement presents certain practical advantages. The practical details of design will be reserved for description after they have been more completely tested by actual experience.

To summarize:

1. The balance arms are shielded individually and collectively in order to make the balance invariable and definite.

2. Shielded transformers are introduced into the generator and telephone branches in order to make the arrangement practicable.

3. The bridge corners are suitably shielded or their admittances to the outside shield suitably proportioned in order to make the numerical computations simple.

Important Electric Railway Tests at St. Louis.

Among the most valuable technical features of the St. Louis Exposition will be the elaborate series of electric railway tests which will be conducted there under the auspices of a special commission appointed by the Exposition authorities. The personnel of the Electric Railway Test Commission has already been announced in this paper, and consists of J. G. White, New York, chairman; H. H. Vreeland, New York; W. J. Wilgus, New York; James H. McGraw, New York, and George F. McCulloch, Indianapolis.

On the grounds of the Exposition the authorities will provide special tracks, having an almost level grade and well ballasted, for the operation and testing of railway car and locomotive equipments. These special tracks consist of one section, 1,400 ft. in length, and one section 2,000 ft. in length, the two sections being parallel. Upon these tracks it is proposed to carry on the greater part of the operating, acceleration, braking, coasting and motor-heating tests, as well as tests to determine car and train friction.

In addition to the trials which will be conducted on these tracks, as detailed above, the commission will carry on a number of tests in the Electricity Building. All of these tests will be supervised by some engineer of national reputation, to be selected later, and all instruments and appliances used in connection with them will be calibrated by the National Bureau of Standards. The latter bureau will erect in the Palace of Electricity a laboratory for this purpose, equipped with all appliances needed for the accurate standardization of all the instruments, meters, etc., required. Before deciding upon the detailed tests to be made, the Test Commission appointed four engineering committees to draw up a series of recommendations of the various tests, which, in their opinion, would cover the main branches of electric railway work as at present developed. These committees were as follows: Engineering Committee on Test of City and Suburban Equipments—M. G. Starrett, chief engineer, New York City Railway Company; D. F. Carver, chief engineer Public Service Corporation, of Jersey City; W. S. Twining, chief engineer Philadelphia Rapid Transit Company. Engineering Committee on Test of Interurban Equipments—A. L. Drum, assistant general manager Indiana Union Traction Company; Chas. Jones, chief engineer Elgin, Aurora & Chicago Railway; C. A. Alderman, chief engineer Appleyard System, Springfield, Ohio. Engineering Committee on Test of Heavy Traction Equipments—F. J. Sprague, New York City; Bion J. Arnold, New York City; W. J. Wilgus, New York Central & Hudson River Railroad, New York City; F. R. Slater, assistant engineer to L. B. Stillwell, New York City. Engineering Committee on New Electric Railway Systems—Bion J. Arnold, New York City; Paul M. Lincoln, Westinghouse Electric & Manufacturing Company, New York City; W. B. Potter, General Electric Company, Schenectady, N. Y.

The following are briefly the tests which have been recommended by the first two of these committees, and which have tentatively been adopted by the commission. The digest of the tests in the departments of heavy traction equipments and new electric railway systems will be published is an early issue.

The tests on apparatus in the Electricity Building suggested are as follows:

1. Tests of various kinds of electric railway motor equipments under constant load, regulated by brake, to determine rate of heating (*a*) of the armature, (*b*) of the field coils.

2. Tests of electric railway motor equipments of the various kinds, to determine the motor efficiency under different fixed conditions of operation, including varying number of stops per mile.

3. Tests on motor equipments to determine their torque curves and accelerating power.

4. Tests on electric railway motor equipments under constant loads, to determine the rheostatic losses corresponding to various lengths of time consumed in application of full-current strength.

5. Tests on electric railway motor equipments to determine at what loads, speeds and frequency of stops it becomes economical to adopt automatic control in place of hand control for single cars.

6. Tests of hand, automatic and multiple-control systems to determine their relative economy, certainty and regularity of starting motor car equipments under fixed conditions of load and track.

7. Tests of electric railway motor equipments to determine safe load during continuous operation, as compared with rated capacity of motors.

The tests on the experimental track are as follows:

8. Tests to determine the relative values of two-motor and four-motor car equipments (*a*) as to power consumption with fixed loads, and with varying loads; and (*b*) as to acceleration with both fixed and varying loads.

9. Tests to determine the proper method of mounting a two-motor equipment on an eight-wheel, two-truck car, viz.: on which two of the four axles shall the motors be mounted?

10. Acceleration tests on single cars and on motor cars and trailer, showing rate of acceleration and power used with both hand and automatic control.

11. Comparative tests on different types of power brakes, both electric and mechanical, in respect to efficiency and economy.

12. Braking tests on single car and on motor car with trailer, under varying conditions, with both hand and power brakes.

13. Tests on single car equipments to determine motor and truck friction at different speeds.

For tests on storage battery cars the following are recommended:

14. Tests to determine the efficiency of batteries under maximum, average and varying loads; also

15. Tests to determine life of batteries under average and adverse conditions of service.

The tests on apparatus to be conducted in the Electricity Building for interurban equipment are largely the same as those recommended for city equipment. For the experimental tracks the committee has recommended a series of tests with various classes of cars and equipments, provided time will permit. If only one type of equipment is tested the committee suggests a car body weighing 16 tons to 20 tons, exclusive of trucks and motors, with a pair of trucks weighing 8 tons to 12 tons per pair and a standard four-motor equipment of 75-hp motors, equipped with different types of hand and train controlling apparatus.

The three points to which effort will chiefly be directed, in case facilities for conducting high-speed tests are available, are as follows:

1. The relation between the average electrical losses in the motors and the rise in temperature attained under various conditions of high-speed service.

2. The train resistance (or power required to propel a car or train at uniform speed) at very high speeds.

3. The performance of cars equipped with controllers so arranged that the acceleration is automatic, as compared with the performance under similar conditions, where the rate of acceleration depends upon the handling of the controller by the motorman.

In the test on electrical losses an effort will be made to determine, of course, the average losses at different schedule speeds with a given rise in temperature and with different periods of stops and lay-overs.

The train resistance tests recommended are with single cars, and also with trains made up of different numbers of cars at various speeds, from 40 miles per hour upwards, and measured in different ways, viz.: by direct measurement of instantaneous power input when running at uniform speed, and by the coasting method.

In the test of control systems it is proposed to investigate not only the efficiency of different systems of control, but the effect of automatic acceleration on the power consumption, etc.

Cables for Electric Light and Power.

The current issue of the *Electric Club Journal* prints a lecture delivered by Mr. H. W. Buck February 29 before the Electric Club, of Wilkinsburg, entitled "The Installation of Electric Cables," in which the subject is considered from the standpoint of electric light and power work. In opening Mr. Buck said that if statistics were compiled it would be found that more shut-downs of electric power plants had their rise in cable trouble than from any other cause—not troubles which could be blamed upon the cable manufacturer for defects in construction, but ones which are directly attributable to dangerous methods of installation. Referring to lead-covered cables, he says that these should not be used in a power house except in places where protection against water is required. The lead sheath being necessarily grounded makes the cable vulnerable to puncture from ground throughout its entire length, which danger does not exist in a braided cable. On account of the softness of lead, it serves as a very poor guard against mechanical injury. If a lead-covered cable is struck the grounded lead is very likely to be driven through the insulation to copper, and the cable is put out of business. Braid-covered rubber cables are not exposed to this risk. As a protection against fire, a lead covering is useless, for the lead melts at a very low temperature, and exposes the inflammable insulating compound to ignition. When once started, a lead-covered cable will support its own combustion until completely destroyed.

In high-voltage work a single-conductor lead-covered cable is especially objectionable. Static discharges seem to take place through the insulation to the lead, which rapidly injures the insulation—especially rubber—and a break-down soon follows. I have known a number of instances where such single-conductor cables have withstood a test of three times normal voltage and have broken down at normal voltage a few hours after being put in service. These break-downs occur usually near the ends of the cable. In multiple-conductor cables this action does not seem to occur, the static activity probably being neutralized.

The present practice of putting cables in ducts as a protection from fire is condemned. As a general proposition, especially in high-voltage work, the best way to wire a power house is to use braided rubber insulated wire, supported in free air upon porcelain or other insulators which in themselves have sufficient insulation to withstand the operating voltage of the cable. The rubber insulation then serves only as a safeguard to life in case of momentary contact, and to prevent a short-circuit in case of temporarily lying tools or such things upon the cables. Cables should be spread out as far as possible from each other, in order to obtain the best possible ventilation and to minimize trouble in case of short-circuit.

Attention is called to the fact that the temperature of the outside of a cable does not indicate its maximum temperature. Some experiments made at Niagara by Mr. H. W. Fisher show that there may be a difference as high as 40° C. between the outside of the cable and the inside of the insulation. For this reason cables should have their outside temperature kept lower than is ordinarily the case. In laying out a cable system the matter of ventilation should, therefore, be regarded as of prime importance. The following method of fire-proofing cables, which is employed by the Niagara Falls Power Company, was given:

Asbestos strip, about 3 in. wide and 3/16 in. thick, is soaked in a silicate of soda solution until it is thoroughly impregnated. It is then, while soft, wrapped spirally around each cable, which has been put in place on its rack in the subway. This covering very quickly hardens and forms a coating like stone over the braid of the cable, which is fire-proof. Asbestos applied in this way has many advantages. It needs no binding wire or steel bands to hold it in place around the cable, which are apt to uncoil when most needed, for the silicate serves as a firm bond. Furthermore, the asbestos, having its pores entirely filled, becomes a good conductor of heat, and the heat from the copper losses can get out by conduction. Dry asbestos, on the other hand, in a porous, cloth-like condition, is a good insulator of heat, which is likely to subject the insulation of the cable wrapped with it to a high temperature. The method described has been given severe fire tests, and it has served its purpose in every case.

In underground cable work the lead covering is absolutely necessary for cable protection on account of water, and also because paper cables must be used for reasons of economy, and all cables must be drawn into ducts underground, for any form of subway with bracket supports for the cable would be prohibitive in cost. The objection to the single-conductor lead-covered cables still holds for underground use for voltages over 5,000. Such high-voltage conductors should, if possible, be placed in the form of multiple-conductor cables, where breakdown in insulation from static effects is seldom experienced if liberal-sized bells are used at the terminals of the cable.

Cable ducts should never be grouped more than two in width, in order that every duct may have an outlet for heat conduction through the surrounding earth. The heating in ducts should not exceed three watts per duct-foot for copper loss in the cable. In conduits built of insulating material, such as vitrified clay, little trouble need be feared from electrolysis if the conduit is well drained and dry. If the ducts, however, contain water and the cables are partially submerged, the lead covering will rapidly disintegrate, unless the sheath is bonded at frequent intervals to the nearest railway return circuit.

Where single-conductor lead-covered cables are used in underground installations for carrying large alternating currents at low voltage, trouble from induced current in the lead sheath should be guarded against. This does not refer to local eddies, but to the current which flows in the lead sheath of two parallel cables as secondary induced by the current in the copper of the same cables as primary. When the lead circuit is closed at two manholes by contact with supporting iron brackets the current which flows in the lead is very considerable, and the resulting loss is nearly equal to the I^2R loss in the copper, even at 25 cycles. At higher frequencies this loss will probably be greater. As a specific example some readings were cited which were taken on two parallel 300-ft. length of 1,250,000-cm. cable carrying 800 amp. in the copper at 25 cycles. The open-circuit voltage induced in the lead was 15 volts, and with the lead sheaths short-circuited at one end through an ammeter, the current was found to be approximately 200 amp. These figures indicate that the matter is one of the greatest importance, and special precautions should be taken in all underground work to meet it. The lead sheaths of all cables should be either bonded together carefully in every manhole or else carefully insulated. If neither one thing nor the other is done, sparking will occur from this lead current at the cable supports at the manholes, which will burn through the lead sheaths and cause a break-down.

The Economy of Reciprocating Engines at Light Loads as Compared With That of Steam Turbines.

By J. A. Seymour.

A NUMBER of articles have been recently published giving comparisons between the steam consumption of turbines and reciprocating engines, in which a relatively poor economy for reciprocating engines at light loads is assumed. This assumption is unwarranted by the actual performance of these engines. Whatever advantages in actual commercial use the steam turbine may ultimately prove to possess, there are no indications at the present time that among these advantages will be a better sustained economy at light loads than with the reciprocating engine. It is true that "the usual" or "average" rate of steam consumption of reciprocating engines at light loads is excessive, as compared with the full-load economy, but the usual or average reciprocating engine is really an uneconomical and out-of-date machine. The ideal reciprocating engine working with non-conducting cylinder walls, without loss from leakage, cylinder condensation or radiation, should expand to back pressure to secure greatest economy. To expand to back pressure in an actual engine would load it much below its most economical point. It follows that since a modern engine of economical type, having a much lower rate of steam consumption at full load, approaches more nearly the ideal engine than the above-mentioned average engine, it should effect proportionately a still greater saving at light loads; that is, it should have a flatter economy curve. In actual practice this is found to be true.

It is manifestly proper that a steam turbine should be compared, as regards economy at light loads, as well as at full load, only with an engine of some economical type which fairly represents the best practice of the present time, and also that in computing the difference between electrical and indicated horse-power readings the combined efficiency of a well-designed, up-to-date unit, should be assumed. The well-sustained economy at light loads of a reciprocating engine is well illustrated in Fig. 1, in which are plotted economy

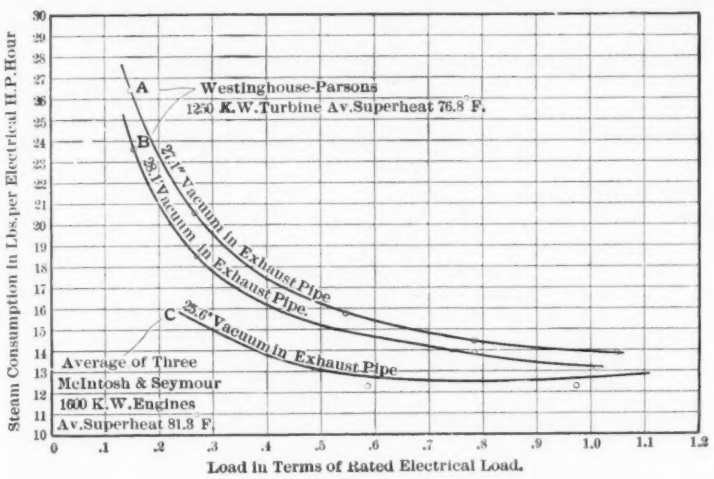


FIG. 1.—ECONOMY AT DIFFERENT LOADS.

curves in terms of electrical horse-power obtained from the results of a shop test of a 1,250-kw Westinghouse-Parsons turbine, described in an article by Mr. A. M. Mattice in the Electrical World and Engineer for February 20, and also the results of acceptance tests of three 1,600-kw McIntosh & Seymour engines referred to in a paper by Messrs. Moultrop and Curtiss, presented at the Boston meeting (May, 1902) of the American Society of Mechanical Engineers, published in Vol. XXIII of the transactions of that society.

Each engine is of the vertical cross-compound type, with a direct-driven 1,600-kw, direct-current generator of the General Electric Company make, and runs at a speed of 100 r.p.m. The cylinders are 29-in. and 60-in. in diameter, with a stroke of 56 in., and the engine, as is usual with this make, is provided with an interheating receiver which superheated the steam entering the low-pressure cylinder during the test from 55° F. to 69° F. The steam condensed in the jackets and heating coils in the receiver is included in the rates of steam consumption given. As stated by Messrs. Moultrop and Curtiss, no troubles have been occasioned by the use of superheated steam with these engines, although of standard construction throughout, which is true in all power stations where these engines have been used with superheated steam.

The economy curve, *C*, represents the average results of all tests made with superheated steam and with receiver heating coils in use upon engines No. 9, No. 10 and No. 11 in the station. The tests of engine No. 8 are excluded on account of conditions which prevented the correct economy of the engine from being ascertained. The best results obtained (with engine No. 9) are also indicated.

It should be understood that these were not shop tests made by the builders under ideal conditions, securing results not obtainable later in actual service, but were acceptance tests instituted by the purchaser to determine upon the fulfillment of contract conditions made at different times under actual working conditions after the engines had been from four to seven months in regular service. All instruments used for taking observations in the tests were accurately calibrated for each test, including the special instruments, used in the tests only, for taking electrical readings. The results were quite consistent for all three engines, the two tests indicated for engine No. 9 showing a greater variation from the average curve than any other test. The average results of tests obtained in such a manner from three engines should be unusually accurate and reliable. The conditions of steam pressure, superheat, etc., also correspond quite closely to those of the turbine tests except that the average vacuum was not nearly as good.

The nominal full-load rating of these engines, on the basis of 165 pounds gauge pressure at the throttle valve and 27-in. vacuum in the exhaust pipe, corresponds to 22/100 cut-off in the high pressure, or approximately to 19½ expansions by volume. The governor allows a maximum cut-off of over 7/10 in the high-pressure cylinder, which permits of a large working overload. It will be noted not only that the economy curve for the reciprocating engine shows a better result at light loads, but also that the point of greatest economy is more favorably located than for the turbine. Central station managers will hardly consider it practical to run steam turbines at their most economical loads without a greater overload capacity than it is proposed to give them, where the station load is a fluctuating one. At times of maximum station load it quite often happens that the steam pressure and vacuum fall off and the loss of pressure in the pipes, etc., increases so that the actual maximum output of the unit under these conditions may fall short of the nominal overload capacity under normal conditions to a serious extent. In the case of a turbine a very high vacuum is necessary in order to maintain either its capacity or its economy. To secure this high vacuum, particularly under heavy overloads and in warm weather, with condensing apparatus of a commercially practicable size, in most locations, will be an extremely difficult problem, a much more difficult problem than is generally understood, but one which will have to be met.

Additional data concerning both the turbine and engine tests for half and full loads are tabulated in the accompanying table. The results given for the turbine at half load with 28-in. vacuum are estimated, no test being reported. These data include the British thermal units per indicated horse-power per minute, and the ratios of the actual thermal efficiency to the efficiency of a corresponding ideal engine working on the Rankine cycle recommended as a standard of comparison by the Institution of Civil Engineers of Great Britain, assuming in all cases a feed water temperature corresponding to that of saturated steam at the pressure in the exhaust pipe. The British thermal units and the efficiency ratios on the basis of electrical horse-power are also given. In the latter case a perfect engine and dynamo, having a combined efficiency of unity, is assumed.

The water condensed in the receiver coils is included in the rates of steam consumption for reciprocating engines. In order to measure this water accurately during the tests its heat was necessarily wasted. In computing the British thermal units and the efficiency ratios this water was assumed to be returned to the boiler at a temperature of saturated steam 5 pounds below the throttle pressure, as this actually takes place in regular working conditions. The heat saved in this way amounts to between 1½ per cent. and 2½ per cent. of the total.

The consumption of British thermal units per horse-power per minute is more closely related to the coal pile than the pounds of steam, and the efficiency ratios afford by far the best means of comparing the economy of different engines. They take into account the more or less favorable conditions of steam pressure, superheat and vacuum under which the engines operate. Any increase of economy which is secured by increasing this ratio is so much clear

gain. On the other hand, if a lower steam consumption is obtained entirely by raising the temperature of the steam supplied and lowering that of the exhaust, it is always partially (and may be more than entirely) offset by both an increase in first cost and an increased cost of maintenance for boilers, condensers, piping, etc. The efficiency ratio given in Fig. 2 for the reciprocating engine at full load exceeds

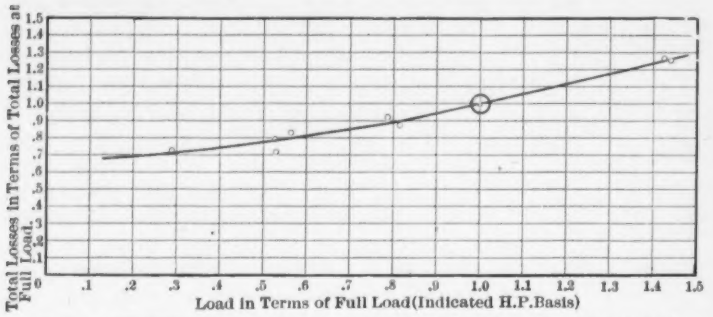


FIG. 2.—RELATION OF LOSSES AT DIFFERENT LOADS AND FULL LOADS.

that of the turbine by 15 per cent., while at half load it is 33 per cent. higher.

The combined efficiencies of these engines and generators were remarkably uniform for all cases, varying from the average less than 1 per cent. at either half or full load. A curve showing the relation of the total losses at various loads to the total losses at full loads plotted from reliable observations from a number of engines similar to these is shown in Fig. 2. While the total losses are fairly constant as predicted in the article of Mr. Mattice, there is an appreciable falling off for lighter loads. When the tests represented by curve *C*, Fig. 1, were made it was not considered worth while to make any determinations for less than half load. The form of the economy curve for these engines, however, has been determined by other tests for from quarter load to 50 per cent. overload, both with and without superheat.

A 1,500-kw McIntosh & Seymour engine recently tested by Prof. Ira N. Hollis, of Harvard University, under the direct supervision of Prof. L. S. Marks, is similar to these engines in every way, except that the stroke is shorter. The test conditions also were nearly identical except that the superheated steam was from 55° F. to 70° F. and the steam pressure somewhat lower. The efficiency ratios obtained in this series of tests on the basis of indicated horsepower for full, half and quarter load were .742, .733 and .668, and the B.T.U. 227, 227 and 242, respectively. For the curve *C* in Fig. 1. the corresponding ratios are .742, .768 and .690 and the B.T.U. 216, 208 and 232, showing a very fair agreement. In general, the results of tests of similar engines at different loads on the basis of indicated horse-power show the curve for overload to be nearly a straight line with a gradually increasing rate of steam consumption. For engines tested without receiver coils in use, and without superheat, an economy constant within two per cent. is indicated for from about .6 load to 1.3 load. The corresponding limits for the same engines with receiver coils in use are from .5 load to 1.2 load, and with superheated steam from 75 to 100° from .4 load to full load; the point of best economy becomes earlier as the rate of steam consumption decreases.

RESULTS OF TESTS AT FULL LOAD AND HALF LOAD.

	Rated Capacity in Kilowatts.	Test Load in Electrical H. P.	Steam Pressure at Starting Valve.	Superheat at Starting Valve.	Vacuum in Exhaust Pipe.	Steam Consumption in Lbs. per Indicated H. P. per Hour.	British Thermal Units per I. H. P. per Minute.	Thermal Efficiency (I. H. P. Basis).	Ratio of Therm. Eff. to That of Ideal Engine.	Combined Efficiency.	Steam Consumption in Lbs. per Electrical H. P. per Hour.	British Thermal Units per E. H. P. per Minute.	Thermal Efficiency (E. H. P. Basis).	Ratio of Th. Eff. to That of Ideal Engine with Perfect Dynamo.
FULL LOAD.														
Average of McIntosh & Seymour engines No. 9, No. 10 and No. 11	1600	2003	160.6	88.4	25.6	11.54	216.1	19.63	.742	.909	12.69	237.7	17.84	.674
McIntosh & Seymour engine No. 9	1600	2014	161.85	92.3	25.42	11.21	209.6	20.24	.768	.912	12.29	229.8	18.46	.70
Westinghouse-Parsons turbine	1250	1735	146.3	76	27.1						13.78	263.5	16.09	.586
	1250	1708	146	78.3	28.1						13.17	255.3	16.61	.573
HALF LOAD.														
Average of McIntosh & Seymour engines No. 9, No. 10 and No. 11	1600	1146	163.7	74.3	25.6	11.25	208.2	20.37	.768	.870	12.93	239.3	17.72	.668
McIntosh & Seymour engine No. 9	1600	1206	167	78.3	25.8	10.72	198.9	21.33	.797	.878	12.21	226.5	18.72	.699
Westinghouse-Parsons turbine	1250	891	151	77	27.15						15.9	304.5	13.93	.503
	1250	875	149	76.9	28.08						15.1	292.5	14.50	.500

An Electrified English Steam Railroad.

Aside from several lines on the Continent, England is the first country to apply electricity to heavy railroading; and this not through the electrical equipment of a new line, but by displacing steam on

FIG. 1.—VIEW SHOWING THIRD AND FOURTH RAILS.

an old road. The Lancashire & Yorkshire Railway, to which we refer, was described as to its location and electrical equipment in our issue of January 30, and we give below the details of the track construction.

The track is furnished with two third rails, one for distributing and one for returning the electric current to the power stations. The former is carried alongside each track in the usual way, while the other rail is placed between the running rails, uninsulated on the ties, this forming the principal part of the return circuit. While the joints of both the third and the fourth rail are bonded in the ordinary way, in the manner described below, the fourth rail is, also, cross-bonded to the running rails at their ends. While, by this arrangement, the troublesome bonding of the running rails is avoided, as are also the complications involved in using an insulated fourth rail for the return, the further advantage is obtained that the iron in the running rails are utilized as part of the return current. No collector shoe is provided on the train for the fourth rail, the current being delivered through the wheels to the running rails, and thence through the cross-bonds to the fourth rail. The insulation of this rail also makes it a comparatively simple matter to renew the running rails, without unduly interfering with the continuity of the return circuit.

The third and fourth rails are both of equal section, and consist of mild steel of special high conductivity, the resistance being proved by test to be not greater than seven and one-quarter times that of

pure copper. As a matter of fact, the average resistance is somewhat lower. The rails weigh 70 pounds per yard, and are in lengths of 60 ft.

The third rail is supported at intervals of about 10 ft. on insulators of reconstructed granite, held in position by two clips, the center of the rail being exactly 3 ft. 11½ in. from the center line of the track, and the top of the rail 3 in. above the surface of the track rails. This dimension may be regarded as the British stand-

FIG. 2.—A CROSSING AT SAND HILLS

ard, having been agreed upon by all the main line steam railroad companies, at a meeting held at the Railroad Clearing House, on March 3, 1904, in order to obtain uniformity in case of extensions of third-rail system. It is of ample section to convey the full amount of current required by the trains, when between two substations, without causing any appreciable loss in voltage. Generally the third rail is placed in the 6-ft. way between the tracks, but occasionally it is brought outside the track to suit special conditions, and

FIG. 3.—JUNCTION AT SAND HILLS.

at all grade crossings the gaps are bonded with cable underground. Timber guards have been provided at all the busy places on the line, to prevent the possibility of any person coming into contact with the third rail. The fourth rail is supported on wooden blocks, and is placed in the middle of the 4-ft. way, between the two running rails.

At most stations the third rail is interrupted and the ends are connected by cables to section switches. This apparatus consists of four knife switches, one for each end of the up and down line, which, in the ordinary way of working, are connected in parallel. By cutting out one of these switches in two adjacent boxes any part of the up or down line may be made currentless.

In providing for expansion and contraction, due to change of temperatures in the rails, they are divided into sections of 300 ft., and the joints between the rails making up this section are known as "fixed joints." The joints connecting the sections themselves are known as "expansion joints." At the fixed joints no provision is made for expansion or contraction, this being concentrated at the expansion joints. The fish-plates at the fixed joints are made as rigid as possible, and the bonds are four in number, two bonds being fixed in the web of the rail and two bonds in the flange of the rail.

It was deemed advisable to use bonds of semi-flexible type, which have a conductor built up of parallel strands of copper ribbon or "flat wire" with solid copper terminals. They are thus sufficiently flexible to provide for any movement which may take place at the joints, and are more easily adjusted in case of any variation in distance between the bond holes at the time of construction. The bonds at the expansion joints are four in number, of the same cross-section as those at the fixed joints, but all four are fixed in the flange of the rail. These bonds are also made of "flat wire."

The fish-plates at the expansion joints are of special design and properly slotted to provide for any change of length which may take place in the 300-ft. section. This system of bonding is carried out on both the third and fourth rails. The terminals of all the bonds are of solid copper, and are expanded in the bond holes by

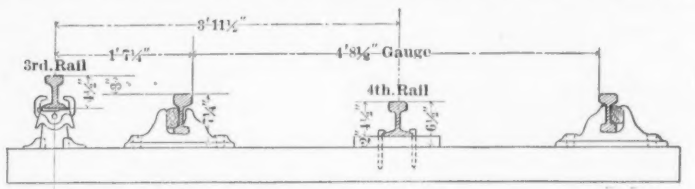


FIG. 4.—CROSS SECTIONAL VIEW OF TRACK AND CONDUCTOR RAILS.

means of screw or hydraulic compressors. Each track rail is bonded to the fourth or negative rail by means of flexible cable bonds. The bonds were supplied by the Forest City Electric Company.

Of the accompanying illustrations, Fig. 1 shows a section of ordinary track, Fig. 2 a section at a crossing and Fig. 3 the track at a junction. The traction rails and third and fourth (conducting) rails are shown in the cross-sectional view, Fig. 4.

Wireless Telegraph Newspaper at Sea.

A project is being worked out to publish a "multiple" daily newspaper on the Atlantic steamships each summer. The Marconigram says: "The newspaper will be of standard size, and will contain full telegraphic reports from the Associated Press. Its advertisements will be contracted for ashore, and it is expected that a very profitable business will thus be established. The combined circulation of this journal on board all steamships will be large enough to warrant its use by advertisers, whereas the issuance of different papers on board each separate vessel renders none of them a profitable medium, by reason of the comparatively small circulation of each. The projector of this publication is said to have contracted with the Marconi Company to receive as many words per day as the company can transmit with its facilities, at a rate per word which will prove extremely profitable to the company. The same matter will be printed in each edition of the paper, whether issued on board the *Lucania*, the *Kaiser Wilhelm* or the *Minnehaha*. The editorial rooms will be located ashore, either in America or Europe, and the news, editorials and miscellaneous matter for each edition will be furnished fresh each day by wireless, as well as the changes for advertisements. This is rather a revolutionary undertaking, but by no means chimerical. There are at times a population of 20,000 to 30,000 people afloat in ocean steamers between the United States and Europe. To furnish this vast multitude with a summary of the day's happenings, in various languages, is an enterprise which cannot fail to become popular."

Annual Report of the Bell Telephone System.

President F. P. Fish has made the following annual report to the stockholders of the American Telephone & Telegraph Company:

The results of the business for the year 1903, as shown by the treasurer's statement appended, were as follows:

Gross Revenue	$16,545,632.39
Expenses, including interest and taxes	5,980,967.30
Net revenue	10,564,665.09
Dividends paid	8,619,150.75
Carried to Reserve	728,139.97
Carried to Surplus	1,217,374.37

The following were the corresponding figures for the year 1902:

Gross Revenue	$13,277,457.33
Expenses, including interest and taxes	5,442,185.14
Net revenue	7,835,272.19
Dividends paid	6,584,403.75
Carried to Reserve	522,246.71
Carried to Surplus	728,621.73

The net output of telephones during the year 1903 was 629,197, making the total number in the hands of licensees 3,779,517. The number of exchange stations at the end of the year was 1,525,167, an increase of 247,184. The total mileage of wire for exchange and toll service was 3,958,891 miles, of which 677,229 miles were added during the year. Including the traffic over the long-distance lines, the daily average of toll connections was about 258,000, and of exchange connections about 9,876,000, as against corresponding figures in 1902 of 239,700 and 9,323,000; the total daily average for 1903 of connections both toll and exchange reaching 10,134,000, or at the rate of about 3,263,000,000 per year.

The total amount added to construction and real estate by all the companies constituting our system in the United States, during the year 1903, was:

For Exchanges	$24,060,900
For Toll Lines	8,866,000
For Land and Buildings	2,441,800
	$35,368,700

The amount added in 1900 was $31,619,100; in 1901, $31,005,400; and in 1902, $37,336,500.

The expenditure by this company in 1903 for the construction, equipment and supplies required for its long-distance lines was $4,365,614, making the total investment in long-distance lines and equipment up to the close of the year $26,861,805.

The development and course of the business of the company during the year have been satisfactory and the returns, as indicated by the foregoing figures, clearly such as to meet all reasonable expectations. In view of the general business conditions of the country, the increase in the number of subscribers and in the amount of telephone business done, shows that the efforts of your company and of the companies associated with it to give a service of substantial value, are appreciated by the public. The increase in gross and net revenue and in the amount carried to reserve and to surplus after the payment of interest and dividends, is a satisfactory indication that the investment that has been and should be made from year to year to build up a comprehensive telephone system that is adequate to the needs of the community will receive a proper return.

In former reports to the stockholders the necessity for developing and extending the facilities of your company to meet the demands of the public throughout the United States has been recognized and asserted. The history of each year emphasizes the soundness of this policy. Not only have the specific returns from such extensions proved to be adequate, but the strength and earning capacity of the company in all parts of the country are definitely increased by such development. No new toll lines are built, exchanges established, or telephones installed, without bringing in additional revenue from the construction already existing, as well as from the new construction. The conditions of modern business require communication over such large areas, and with so many people, that the public immediately responds when it has the opportunity of telephonic communication with new territory or with new subscribers; for the value of the service to users generally, largely increases with the extent of territory covered and the number with whom connections may be made. Your company and its associated companies are in a position to supply the comprehensive service required, and a proper return for the investment will surely reward their efforts to meet the demand that is made upon them. The extent of development required will vary from time to time with general business conditions. But even when those conditions are least favorable, extension of telephone facilities will still be called for, inasmuch as each year a larger proportion of the community recognizes the importance of the telephone in social and business life, as is shown by the constantly increasing number of Bell telephones in proportion to population.

Equally important is the matter of good service. Our companies are thoroughly impressed with the necessity of maintaining the Bell service at the highest practicable standard, and every effort is made to produce this result. The constant and intelligent study of operating methods that has been going on from the beginning and the many successive improvements in apparatus, have resulted in a definite control of this problem, the effect of which is everywhere shown in improved service. The complicated equipment required to make it possible to establish intercommunication between any two of hundreds of thousands of telephone users has now been standardized to a large extent. Standard methods of operating have been devised and put into practice. The result is not only an increased efficiency and better service, but also marked economy in maintenance and operation. Improvements in cables and devices to be used in connection therewith, and greater engineering knowledge, have made it possible to develop underground construction to a constantly increasing extent, and the field for underground work is now believed to be capable of an ultimate extension beyond anything that seemed possible to the engineers of a few years ago. This results in economy of operation and also, by reducing to a minimum the danger of accident to the outside construction, in an improvement in the service. It is safe to say that there is an element of permanency in the apparatus and equipment of to-day which did not characterize that in use a few years ago. The time will never come when further improvements may not be expected, both in methods of operating and in apparatus. There is no doubt, however, that the telephone service has now been so far standardized in these respects as to be on a par with many industries that are much older and which have had the intelligent and careful study of experts for a far greater period of time.

The work of perfecting the Bell service is not complete; but in view of the zeal and intelligence with which it is being pushed throughout the country, there is every reason to expect that the high standard now definitely established, and already attained in many places, will characterize the service generally.

In the report to the stockholders for the year 1902, reference was made to the significant fact that many of the competing telephone companies were beginning to realize that the rates adopted by them were too low and were seeking to raise those rates. This movement has continued with added force during the year 1903. The competing companies, in almost every city of any size in the country in which they have established exchanges, have found, sometimes as the result of a bitter experience, that the cost of doing the business was far greater than they anticipated. This has resulted in an increasing number of efforts on their part to raise their rates to a point nearer the Bell standard.

In particular they have learned that charges for maintenance and depreciation, which were lost sight of during the promotion stage of their business, were necessary expenses which must be taken care of before there was any question of earnings applicable to interest on bonds or dividends on stock.

The lesson has not even now been thoroughly learned, and not unfrequently the prospectuses of competing companies practically ignore those expenses. It is common for them to present figures showing that the entire cost of carrying on the business is from forty-five to sixty per cent. of the gross receipts that may be expected. The history of the business shows conclusively that an attempt to operate a telephone plant on any such basis is doomed to failure.

This matter of maintenance and depreciation is constantly before the eyes of our companies. The system of accounts, which is practically uniform for all the Bell organizations, forces them fairly to face this expense from month to month and from year to year. Before there is any question of profits, each company recognizes the necessity of reserving from its earnings such amounts as experience has shown to be adequate to keep its property in repair and replace it when worn out or destroyed. The sum properly to be charged varies to some extent in different parts of the country, on account of climatic conditions and the character of the plant employed, but the average allowance for maintenance of the Bell companies for the year 1903 was over thirty per cent. of their gross revenue.

As was stated in the report to the stockholders for the year 1902, the competition to which our companies are subjected is embarrassing chiefly to the extent to which it leads the public to believe that service can be given at rates that are too low to permit good service and a reasonable profit. The situation is now more favorable than ever before in this regard, and will continue to improve as the competing companies and the public become more correctly informed as to the conditions of the business. On the whole, it seems every year less probable that competition will have any substantial effect upon the prosperity of the Bell companies.

The developments of the past year also show that the feeling that it is better for the community that there should be one comprehensive system of telephonic communication instead of several, which was referred to in former reports, is clearly growing in all parts of the country.

It is an interesting and significant fact that many telephone companies which have started exchanges and to some extent toll lines in various parts of the country, independently of the Bell companies, but in territory which the Bell companies did not occupy, have by contract with our operating companies taken the Bell telephones and become connected with our system on terms favorable to both parties. There are now over 120,000 of such sub-licensee stations connected with the lines and exchanges of the Bell companies, and the movement in that direction is gaining.

Generally speaking, the business of your company and of the companies associated with it is on a sound basis and, with good management and a proper development to meet the demand, the continued prosperity of the Bell organization seems secured.

The suit of the Western Union Telegraph Company against this company, which has been pending since the year 1884, and which was decided in favor of this company by Judge Lowell, sitting as master, and by Judge Colt in the Circuit Court of the United States, has been decided adversely to this company by the United States Court of Appeals for the First Circuit.

The decision is to the effect that, under a technical reading of the contract made by the predecessor of this company with the Western Union Telegraph Company and its associated companies in the year 1879, this company may have to account to the Western Union Company for a certain percentage of some of the stocks and bonds which it received from its licensee companies prior to 1896, when the contract expired.

That the validity of this decision is doubtful is shown by the fact that Judge Lowell and Judge Colt took a contrary view, and at the proper time every effort will be made to secure a revision of the decision of the Court of Appeals. Meanwhile the matter has been referred to a master, who will report as to the amount, if any, which this company should pay the Western Union Company under the decision of the Court of Appeals, and his report, when made, will be subject to revision by the courts. Even if there should be any ultimate recovery against us—which, as we are advised by counsel, is by no means certain—it is not believed that the amount recovered will be relatively large. It certainly will not be large enough to impose any appreciable burden upon the company. Certain classes of the stocks in question are expressly excluded from the accounting by the opinion of the Court of Appeals, and there are many considerations which, in the opinion of our counsel, will reduce substantially the amount, if any, that may be recovered in the case of the remaining stocks.

Your directors desire to express their appreciation of the zeal and intelligence with which the employees of this company and the officers and employees of the operating companies are co-operating to bring about the best results in our business. There is an excellent spirit throughout the organization and everywhere a harmony of effort and aspiration which is most satisfactory.

The report is accompanied by the foregoing important statistics as to instruments in the hands of Bell lincensees, under rental and by the financial statements given.

THE FIGURES IN LOWER LINE SHOW INCREASE FROM YEAR TO YEAR.

Dec. 20, 1899.	Dec. 20, 1900.	Dec. 20, 1901.	Dec. 20, 1902.	Dec. 31, 1903.
1,580,101	1,952,412	2,525,606	3,150,320	3,779,517
455,255	372,311	573,194	624,714	629,197

This would show 1,889,758 stations.

TOLL LINES IN THE UNITED STATES OF THIS COMPANY AND THE COMPANIES ASSOCIATED WITH IT.

	Jan. 1, 1900.	Jan. 1, 1901.	Jan. 1, 1902.	Jan. 1, 1903.	Jan. 1, 1904.	Increase.
Miles of Pole Lines	89,292	101,087	110,459	122,409	130,178	7,769
Miles of Wire	501,832	607,599	716,265	837,912	975,702	137,790

TOLL CONNECTIONS.

The average daily number of toll connections is	257,618
Or a total per year of about	82,953,000

EXCHANGES OF THE BELL COMPANIES IN THE UNITED STATES.

	Jan. 1, 1900.	Jan. 1, 1901.	Jan. 1, 1902.	Jan. 1, 1903.	Jan. 1, 1904.	Increase.
Exchanges	1,239	1,348	1,411	1,514	1,609	95
Branch offices	1,187	1,427	1,594	1,861	2,131	270
Miles of wire on poles and buildings	524,123	644,730	841,140	1,109,017	1,358,140	249,123
Miles of wire underground	489,250	705,269	883,679	1,328,685	1,618,691	290,006
Miles of wire submarine	3,404	4,203	4,200	6,048	6,358	310
Total miles of wire	1,016,777	1,354,202	1,729,019	2,443,750	2,983,189	539,439
Total Circuits	422,620	508,262	592,467	742,654	798,901	56,247
Total Employees	25,741	32,837	40,864	50,350	53,795	3,445
Total Stations	632,946	800,880	1,020,647	1,277,983	1,525,167	247,184

EXCHANGE CONNECTIONS.

The estimated number of exchange connections daily in the United States, made up from actual count in most of the exchanges, is	9,876,402
Or a total per year of about	3,180,200,000

The number of daily calls per station varies in different exchanges, the average throughout the United States being 6 5/10.

LEDGER BALANCES, DECEMBER 31, 1903.

DEBTORS.		
Construction, Equipment and Supplies	$26,876,805 50	
Telephones	6,767,189 75	
Real Estate	2,009,749 21	
Stocks and Bonds	130,678,449 28	
Patent Account	173,864 35	
Machinery and Tools	48,126 58	
Cash and Deposits	13,319,533 13	
Bills and Accounts Receivable	22,397,407 09	
American Bell Telephone Co	22,110,400 00	
CREDITORS.		
Capital Stock		$154,179,300 00
Capital Stock Instalments		1,972,380 00
Surplus		4,710,664 60
Bonds		28,000,000 00
Reserves		7,942,075 07
*Accounts Payable		8,931,894 97
Contingent		18,645,210 25
	$224,381,524 89	$224,381,524 89

WM. DRIVER, *Treasurer.*

*Of this amount, $2,859,050.25 is for the dividends payable Jan. 15, 1904, to stockholders of record Dec. 31, 1903.

COMPARATIVE STATEMENT OF EARNINGS AND EXPENSES.

	1902.	1903.
EARNINGS.		
Dividends	$6,023,523 20	$7,802,833 63
Rental of Instruments	2,299,378 52	3,047,088 35
Telephone Traffic	4,199,708 59	4,888,158 34
Real Estate	56,030 54	73,332 15
Interest	698,816 48	734,219 92
	$13,277,457 33	$16,545,632 39
EXPENSES.		
Expenses of Administration	$964,827 30	$962,297 84
Legal Expenses	124,645 57	95,564 60
Interest and Taxes	1,970,947 99	1,993,680 08
Telephone Traffic	2,381,764 28	2,929,424 78
	$5,442,185 14	$5,980,967 30
Net Revenue	$7,835,272 19	$10,564,665 09
Dividends Paid	6,584,403 75	8,619,150 75
Balance	$1,250,868 44	$1,945,514 34
Carried to Reserves	$522,246 71	$728,139 97
Carried to Surplus	728,621 73	1,217,374 37
	$1,250,868 44	$7,945,514 34

WM. R. DRIVER, *Treasurer.*

The Telephone Substation.—II.

BY ARTHUR V. ABBOTT, C.E.

SOME experiments upon induction coils have recently been made in the Electrical Engineering Laboratory of the Iowa State College. A set of 23 coils was obtained, four of which were those commonly made by well-known telephone manufacturers, while the remaining nineteen were experimental coils constructed for the purpose of trial. These coils were tested by selecting one (No. 21 of Table No. 4) as a standard and comparing all of the other coils

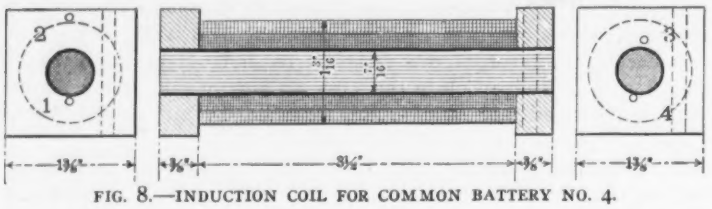


FIG. 8.—INDUCTION COIL FOR COMMON BATTERY NO. 4.

SPECIFICATIONS FOR FIG. 8.

Core: Bundle of No. 24 soft iron wire.
Diameter of core, 7/16 in.
Length of core, 4¼ in.
Winding space, 3½ in.
Paper insulation around core 1/32 in. thick.
End blocks ⅜ in. thick, 1⅜ in. square.
Winding: Inside winding.
Resistance, 28 ohms.
1000 turns No. 33 single silk covered wire, wound in three layers from end to end of core.
Two layers of common paper insulation around it.
Outside winding.
Resistance, 51 ohms.
2500 turns of No. 28 single cotton covered wire wound from end to end of core.
Terminals: 1 and 2 outside winding.
3 and 4 inside winding.
1 to receiver.
2 to hook.
3 to condenser.
4 to hook.

Unfortunately the results shown in Tables 4 and 5 do not lead to the formulation of any rules as to the best proportions to be observed in the design of induction coils. On the contrary, these experiments seem to teach that coils of quite widely varying properties yield fairly satisfactory results. Theory indicates that to secure the very highest efficiency the coil should be proportioned to the particular transmitter, receiver and line with which it is to be connected. In commercial operation this is impossible, so it is perhaps fortunate that practice shows it to be feasible to work over widely differing lines, with coils of many designs and obtain sensibly the

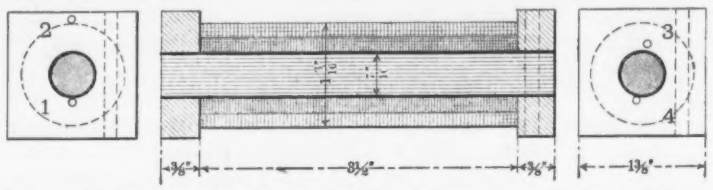


FIG. 9.—INDUCTION COIL FOR COMMON BATTERY SOLID-BACK TRANSMITTER NO. 5.

SPECIFICATIONS FOR FIG. 9.

Core: Bundle of No. 24 soft iron wire.
Diameter of core, 7/16 in.
Length of core, 4¼ in.
Winding space, 3½ in.
Paper insulation around core 1/32 in. thick.
End blocks ⅜ in. thick, 1⅜ in. square.
Winding: Inside winding.
Resistance, 28 ohms.
1404 turns No. 31 single cotton covered wire wound from end to end of core.
Two layers common paper insulation around it.
Outside winding.
Resistance, 17 ohms.
1705 turns No. 26 single cotton covered wire wound from end to end of core.
Terminals: 1 and 2 to outside wiring.
3 and 4 to inside wiring.
1 to line.
2 to hook.
3 to condenser.
4 to hook including receiver.

therewith, first over a line of six miles in length, and then over a line 106 miles. The results of these tests are shown in Table No. 4. The left-hand half of the table gives the electrical properties of each coil. The right-hand half is divided into two parts, one of which gives the results of the tests with the 6-mile line, and the other those obtained from the 106-mile circuit. The opinions of the investigators making these experiments is expressed in the columns headed volume and clearness. The figures therein contained show the idea which was formed as to relative intensity and clearness of articulation of each coil as compared with No. 21.

same results. Probably, therefore, the best guide to the plan of an induction coil is to be found by dissecting a number of coils, that have survived the test of time and experience, and building along the lines thus indicated. As an aid to the designer the proportions used by half a dozen or more of the principal manufacturers, will be found in Table V, while the succeeding drawings and accompanying specifications, still further exemplify the building of induction coils.

Considering the importance of the induction coil, too much pains cannot be taken in its design, or too great liberality allowed in its

TABLE IV.—TESTS ON INDUCTION COILS, IOWA STATE UNIVERSITY.

	Properties of Coils Tested. Primary.				Secondary.								Tests on 6 Mile Line. Transmitter.				Tests on 106 Mile Line. Transmitter.				
Designation of coil.	Number of turns.	Size of wire, B. & S.	Resistance ohms.	Inductance henrys.	Number of turns.	Size of wire, B. & S.	Resistance ohms.	Inductance henrys.	Ratio of turns.	Diameter of core.	Length of core.	Size of iron core wire. No.	Volts at terminals.	Current, amperes.	Per cent volume.	Per cent clearness.	Volts at terminals.	Current, amperes.	Per cent volume.	Per cent clearness.	Relative average efficiency per cent.
1	111	22	.392	.0061	5139	32	157	1.264	46.3	½"	4 "	18	2.83	.155	62.5	72	3.00	.140	163	86	106.7
2	44	22	.14	.0012	2246	32	70.7	.218	61.5	½"	2 "	18	2.80	.172	47.5	67	3.00	.135	77	59	70.35
3	198	22	.62	.0021	2164	32	87.9	.315	10.9	½"	2 "	18	2.83	.159	100	81	2.80	.155	110	80	104.5
4	80	22	.274	.0034	2413	32	76.3	.29	30.16	½"	3 "	18	2.80	.157	27.5	67	2.95	.130	95	81	76
5	44	22	.099	.0012	2688	32	79	.268	61	⅜"	2 "	18	2.85	.158	40	72	3.00	.115	30	28	48.25
7	132	22	.364	00086	2354	32	82.25	.208	17.8	⅜"	2 "	18	2.80	.165	90	77	2.90	.120	105	80	99
8	124	22	.24	.00074	1240	32	43	.079	10	½"	3 "	20	2.90	.163	90	81	2.95	.118	92.5	88	99.15
9	2640	32	73.5	.365	4000	30	134.3	.854	1.5	½"	4 "	18	.95	.040	35	64	1.05	.040	50	40	53.37
10	208	22	.54	.00225	1400	36x32	34.8	.739	6.73	½"	4 "	18	3.00	.113	100	85	2.95	.120	1025	84	103.6
11	400	26	2.08	.00574	1506	28	13.4	.0812	3.76	⅜"	4 "	18	2.85	.105	100	75	2.85	.125	72.5	79	92.25
12	228	22	.52	.00174	900	36	58.4	.0345	4	⅜"	4 "	18	3.00	.105	80	85	3.00	.122	65	79	87.3
13	400	26	2.07	.00497	1241	28	16.3	.0475	3.1	⅜"	4 "	20	2.95	.100	105	73	2.85	.115	825	81	96.25
14	220	22	.481	.0025	5500	36	420	1.124	25	⅜"	4 "	20	2.97	.120	87.5	68	3.00	.120	105	80	95.5
15	262	18	.29	.003	420	22	1.91	.0079	1.6	½"	4 "	20	2.97	.107	82.5	79	3.00	.127	73	75	87.2
16	400	26	2.07	.00525	1700	28	21	.0962	4.25	⅜"	4 "	18	2.85	.105	110	76	2.8	.125	105	66	100.5
17	1409	22	25.8	.04	1800	26	13.36	.0895	1.27	⅜"	6½"	20	1.70	.060	85	67	1.50	.070	48	49	70.6
18	113	22	.393	.0006	554	22	1.71	.014	5	½"	4 "	18	3.00	.113	45	62	3.05	.115	48	67	62.5
19	371	28	3.5	.0054	2503	32	74	.208	6.7	⅜"	2 "	18	2.75	.103	100	77	2.85	.095	105	84	102.7
20	170	22	.56	.0011	2800	26	26	.399	16	¼"	2½"	20	3.00	.108	32.5	63	3.05	.085	63	62	62
21 standard	270	20	.35	.0015	2139	32	32	.0978	7.8	¼"	3½"	23	3.10	.110	100	74	3.2	.110	100	81	100
5G	275	18	.88	.0021	2934	30	84	.278	10.7	⅜"	3½"	23	3.00	.110	100	75	3.05	.110	107	69	99
5H	275	18	.88	.0022	3910	30	217	.463	14.2	⅜"	3½"	23	3.00	.112	102	67	3.05	.110	115	77	101.8

proportions. In its construction and assemblage, the very best material and the highest standard of workmanship should be used. Under increasing competition there is a great and mistaken tendency to skimp both in quality and quantity. The general aim of design should be to produce a coil of the least possible impedance and the greatest mutual inductance. To this end the primary should be of large wire, the core ample in size and long enough to accommodate the necessary turns of the primary, which should not be less than 300 in two layers. The ratio of transformation between the primary and secondary should be from 8 to 10, and the size wire employed in the secondary such as to enable the requisite number of turns to be obtained in not to exceed five layers. For both primary and secondary white single silk-covered copper wire should be used, and it is desirable that each coil should be wound with a single piece without splices. In the winding care should be taken to wind evenly and uniformly without piling or crossing any of the turns. Between the primary and the secondary an insulation of at least four thicknesses of paraffined paper should be provided, and it is well to interpose two thicknesses of paper insulation in the middle of the secondary. The terminals of both primary and secondary should be reinforced by means of stranded wire extended from the inside of the winding through holes drilled in the heads and soldered to clips secured either upon the head or upon the base. The stranded terminal wire should be heavily insulated with a silk or cotton wick. The core should be composed of the very best and softest Swedish iron wire, thoroughly annealed. The wire should not be over a No. 20 B. & S., gauge and preferably No. 26 or 28. It should be thoroughly varnished, cut to proper length and packed into the core tube, and each piece of wire composing the core should be the full length of the tube. Short pieces or spliced pieces should not be allowed.

For the coil frame fibre heads about ¼ in. in thickness and from 1 in. to 1¼ in. square, mounted upon a fibre tube ½ in. in diameter and from 4 to 6 ins. in length is preferable. While many makers use paper tubes and wooden heads, fibre is much more desirable.

TABLE V.—INDUCTION DATA FROM PRACTICE.

Maker.	Secondary Coil. Wire. Gauge: B. & S.	Insulation.	Weight, oz.	Length, ft.	Resistance, ohms.	Turns per layer.	Number of layer.	Total turns.	Insulation between layer.	Tube. Diameter, ins.	Material.	Core. Size of wire: B. & S.	Length, ins.	Number of pieces.	Weight, oz.
Erickson	30	Bare wire Varley coil	1.25	516	60	200	17	3300	Paper	5/16	Fibre	20	3¼	73	.63
Kellogg	29	White silk	1.50	300	20	240	9	2200	Paper	¼	Paper	24	3 11/16	96	.50
Manhattan	34	Cotton	1.37	1045	250	280	19	5350	Paper	7/16	Paper	25	3 7/16	206	.75
Western Tel. Con. Co.	29	Cotton	1.75	350	30	230	7	1650	None	7/16	Paper	20	4	148	2.00
American Electric	28	Green silk	1.125	152	20	215	3	700	None	½	Paper	20	3⅞	176	2.125
Stromberg-Carlson	30	Green silk	2.37	525	50	260	9	2400	Paper	7/16	Paper	20	4¼	128	1.75
Century Tel. Co.	34	Green silk	1.37	900	230	460	10	5000	None	5/16	Paper	23	4½	120	.88
Swedish American	34	Green silk	.875	450	115	336	6	2200	Paper	5/16	Fibre	20	3¾	120	.70

Maker.	General Specification. Length, ins. Over all.	Between heads.	Corimeter, ins.	Body. Covered with	Material.	Heads. Length, ins.	Width, ins.	Thickness.	Gauge, B. & S.	Primary Coil. Wire. Insulation.	Weight, oz.	Length, ft.	Resistance, ohms.	Turns per layer.	No. of layers.	Total turns.	Insulation between layers.
Erickson	3¼	2¾	18/16	Pebble paper	Rubber	⅞	⅞	¼	27	White silk	.25	32	1.75	175	2	350	Paper
Kellogg	3 11/16	3	11/16	Black cloth	Wood	1.00	1.00	3/16	20	White silk	1.00	27	9.10	90	3	300	None
Manhattan	3 7/16	2⅞	1.00	Black paper	Wood	1.00	1.00	¼	22	Cotton	1.00	36	.53	90	3½	295	None
Western Tel. Con. Co.	4	3½	⅞	Black cloth	Fibre	1.00	1.00	¼	27	Cotton	2.36	300	15.50	200	8½	1650	None
American Electric	3⅞	3⅛	1.00	Green cloth	Fibre	1.¼	1.¼	⅜	28	Cotton	2.25	360	9.10	215	9	200	None
Stromberg-Carlson	3⅞	3 11/16	1.00	Black paper	Fibre	1⅛	1⅛	3/16	20	Green silk	1.88	50	.50	110	3	350	None
Century Tel. Co.	4½	3 11/16	¾	Green paper	Fibre	1⅛	1⅛	⅜	23	Cotton	1.63	65	1.50	125	4	500	Paper
Swedish American	3¾	3	1.00	Black cloth	Fibre	1.00	1.00	⅜	22	Cotton	2.25	82	1.30	96	6	550	Paper

Production of Artificial Gas.

A report just issued from Washington, by Mr. Edward W. Parker, gives the following figures of gas production that are of interest. The table shows the total quantity of gas made from coal by the 533 companies distributed over 44 States and Territories. Prices for artificial gas are low in States where natural gas is used largely in the principal cities, as in Illinois, Indiana, Kentucky, Ohio, Pennsylvania, West Virginia and also Massachusetts, where a large portion of the gas made is a by-product from coke-making in retort ovens:

TABLE I. PRODUCTION OF GAS AT GAS-WORKS AND COKE-OVEN PLANTS IN 1902.

Number of plants reporting	533
Coal carbonized, short tons	5,015,511
Gas made, cubic feet	30,764,625,332
Gas sold, illuminating purposes:	
Cubic feet	23,401,318,526
Value	$23,688,963
Average price per 1,000 cubic feet	$1.012
Gas sold, fuel purposes:	
Cubic feet	5,677,755,029
Value	$5,653,918
Average price per 1,000 cubic feet	$0.996
Gas sold, total:	
Cubic feet	29,079,073,555
Value	$29,342,881
Average price per 1,000 cubic feet	$1.009
Gas unaccounted for, cubic feet	1,685,551,777

TABLE II. PRODUCTION OF GAS AT GAS-WORKS IN 1898.

Number of companies reporting	433
Coal carbonized, short tons	2,042,698
Gas made, cubic feet	19,469,464,957
Gas made per ton of coal, cubic feet	9,465
Gas sold, illuminating purposes:	
Cubic feet	15,955,149,507
Value	$18,953,114
Average price per 1,000 cubic feet	$1.188
Gas sold, fuel purposes:	
Cubic feet	2,476,051,907
Value	$2,549,181
Average price per 1,000 cubic feet	$1.0295
Gas sold, total:	
Cubic feet	18,431,201,414
Value	$21,502,295
Average price per 1,000 cubic feet	$1.1666
Gas unaccounted for	1,038,263,543

Of the total amount of gas produced in the United States in 1902, 1,685,551,777 cubic feet, or 5.48 per cent., were lost by leakage or accident. The marketed product amounted to 29,079,073,555 cubic feet, of which 23,401,318,526 cubic feet, or 80.45 per cent., were sold for illuminating purposes and 5,677,755,029, or 19.55 per cent., for fuel. As a usual thing the gas sold for illuminating purposes brought higher prices than the fuel gas, but there were a few instances where fuel gas was sold at high enough figures to make the average price for this gas in the State higher than illuminating gas. The price of illuminating gas varied from 65.2 cents per 1,000 cubic feet in Massachusetts to $2.13 in Montana, Nevada and New Mexico. Fuel gas ranged from 29.2 cents in West Virginia to $1.98 in Oregon. The average prices of fuel and illuminating gas in 1902 for the country as a whole show a difference of only 1.6 cents per 1,000 cubic feet, the former being 99.6 cents and the latter $1.012.

An Electrical Engineer in Thibet.

Mr. Oscar T. Crosby, the well-known electrical engineer, who, during the past few years has devoted a great deal of his time to exploration in the remote regions of the world, including Abyssinia, Somaliland, the Blue Nile, etc., has just returned to this country after a most interesting expedition through Turkestan and Thibet. While in England on his way home he addressed the Royal Geographical Society on the subject, and a number of his friends in this country having invited him to redeliver this lecture, he appeared last week at the American Institute before a gathering of some 400 or 500 people under the auspices of the New York Electrical Society and of fellow-members in the American Institute of Electrical Engineers. The lecture made a most agreeable diversion from the usual programme of the Society and was a delightful and fascinating narrative of adventure and peril in the mysterious region beyond the snowy ranges of the Himalayas, and in a land upon which Russian and British political intrigue is now said to be focussed, the Indian government having recently sent an expedition to Lhassa. For over two hours Mr. Crosby, who has keen powers of observation, a splendid command of language, and a fine sense of humor, held his audience entranced while he detailed the successive stages of his long journey, during the last 50 days of which, spent about 15,000 ft. above sea level, he did not take his clothes off; and during the last five days of which his party was on the very verge of starvation. Although he did not succeed in reaching the capital of the Grand Llama, Mr. Crosby was able to see a great deal of the life and scenery of Turkestan and Thibet and secured a number of interesting photographs, many of which were shown on the screen by lantern. He also brought back with him ancient manuscripts from some of the sand-buried cities of central Asia, whose history still remains in such impenetrable gloom. Before starting on his trip, Mr. Crosby provided himself with a phonograph, upon the cylinder of which his credentials and attributes were set forth in the choicest Chinese dialect of the region visited; but this vocal passport he had to leave behind him with a great deal of other baggage which succumbed to the rigors of the expedition. At the close of the lecture, on motion of Vice-President Mullin and Mr. Frank J. Sprague, an enthusiastic vote of thanks was passed to the lecturer for the great pleasure he had afforded the Society and so many of his old friends. During the evening it was announced that immediately upon the Union Engineering Building becoming an accomplished fact, President Carty had filed with the conference committee, on behalf of the Society, a request that it might be given accommodation and facilities within the building; and that this request had been favorably acted upon. This news was received with great enthusiasm.

Recent Electrochemical Developments.

MANUFACTURE OF SULPHURIC ACID FROM SULPHURETED HYDROGEN GAS.

The Salom process for the reduction of lead from galena consists in the use of a cathode of galena (lead sulphide) in sulphuric acid as electrolyte. The cathodic reaction is the reduction of lead sulphide to metallic lead with a simultaneous evolution of hydrogen sulphide gas. While the main object of the process is the production of lead, yet the hydrogen sulphide is a valuable by-product and something must be done with it. In a patent granted to Mr. P. G. Salom on March 22 a method is described for using it for the manufacture of sulphuric acid.

The hydrogen sulphide gas is first burned, to form sulphur dioxide. The sulphurous-acid gas is then oxidized in the presence of water by means of electrolytic action, the current of gas being subjected to progressive anodic treatment in a series of divided receptacles through which it travels. The process is so conducted as to permit the progressive transfer from time to time of the contents of each receptacle into the next one of the series, and the discharge of the contents of the ultimate receptacle (in which the action has proceeded to the fullest extent) into a receiving tank, the gravel of the liquid contents being in the inverse direction to the flow of the gas through the same. The apparatus used by Mr. Salom is very similar to that employed by him formerly for lead reduction and consists of a stack of trays placed one upon the other.

EXTRACTION OF COPPER FROM COMMINUTED MINERAL MIXTURES.

In a patent, granted on March 22, Mr. E. A. Le Sueur, who is best known by his early pioneer work in the development of the diaphragm cell for the electrolysis of sodium chloride, describes a process for obtaining the copper from mineral mixtures containing only a very small amount of copper, as, for instance, the waste sands from stamp mills. Mr. Le Sueur proposes to treat them by a wet process and his process consists, therefore, of two steps: The first using the solution of the copper, the second its precipitation.

For solution he uses an ammoniacal solution of cupric hydroxide, with the addition of certain apparently inert salts, like ammonium sulphate. If there is no access of air, the reaction is a reduction of the cupric ions, already in the solution, to the cuprous state, while the metallic copper passes simultaneously into solution, also in the cuprous state. While in the sense of the ionic theory this is an electrochemical phenomenon, this step is purely chemical from the practical point of view, since no current is passed from the outside through the solution.

For the second step—the precipitation of the copper from the solution—either chemical or electrochemical means may be employed. In the latter case the author suggests the following cycle, the whole process being conducted in the form of a cycle, as follows: Copper is first dissolved, as described before, in cuprous form, about the same weight of copper going into solution as is contained in it in the cupric state at the start of the operation. Then electrolysis begins with an insoluble anode and as much copper is now deposited upon the cathode as had gone before into solution, while the other part is oxidized from the cuprous to the cupric form at the anode. Then the solution is again in its original condition and may again be used for leaching out other ore.

STORAGE BATTERY INVENTION.

A patent, granted to Mr. S. Lake, of Bridgeport, Conn., relates to mechanical details of the connection of the battery plates of common size to the bus-bar in such a way that individual plates may be easily removed. In a patent, granted to Mr. M. C. Burt, of Chicago, a cooling device is described which is intended to counteract the heating of the solution by Joulean heat.

Mr. C. B. Askew, of Chicago, refers, in a recent patent, to details of construction of a grid for pasted storage battery plates. The grid is made of sheet lead transversely sawed from opposite sides in planes at right angles to the medium plane of the sheet, so that each side of the sheet is provided with parallel grooves. The grid is also provided with perforations.

CURRENT NEWS AND NOTES.

TURBINES FOR CUNARDERS.—Great interest has been aroused in marine engineering and electrical circles by the announcement that the Cunard Steamship Company has decided to adopt steam turbines in the new fast steamers which are to be built under an agreement with the British Government, which will have a gross tonnage of 28,000, which are expected to travel at a speed of 25 knots an hour and will cross the Atlantic in about five days.

WIRELESS AT THE ISTHMUS.—A cable dispatch from Panama of March 26 says: "The postmaster at Panama to-day received official cable advices from Minor Keith, who is in Costa Rica, stating that a system of wireless telegraphy was successfully inaugurated last Thursday between Port Limon, Costa Rica, and Bocas del Toro, Panama. The convention recently held here authorized the President of the Republic of Panama to sign a contract for the installation of this system. Mr. Keith will also establish a wireless station at Colon."

UNDERGROUND CONSTRUCTION.—President Edgar, of the National Electric Light Association, has asked Dr. S. S. Wheeler to act as chairman of the committee to examine the papers of those competing for the gold medal offered by Past President Doherty for the best paper on underground construction, to be presented at the twenty-seventh convention of the association. Dr. Wheeler has consented to serve, and the other members of the committee will be Mr. Louis A. Ferguson and Mr. H. G. Stott. All of these gentlemen are excellent authorities on the subject, and it is hoped that the papers—which are to be handed in before April 21—will be of a character to make their work a most interesting one. Dr. Wheeler, it may be noted, was at one time electrical engineer for the New York Board of Electrical Control, in the early days of its subway work for underground wires.

MUNICIPAL ELECTRICIANS.—There will be a meeting of the executive committee of the International Association of Municipal Electricians on Saturday, April 2, at 10 A. M. at the Astor House, New York City.

POSTPONEMENT OF IOWA ELECTRICAL CONVENTION.—The Iowa Electrical Association convention which was to have been held at Des Moines April 13 and 14 has been postponed one week to April 20 and 21. Headquarters will be at the Hotel Savery.

WIRELESS IN CHINA.—It is stated that the Italian legation at Pekin has been provided with a Marconi wireless telegraphy station which enables direct communication to be maintained with the vessels of the Italian fleet in Chinese waters. Thus the Italian legation will be able to communicate with its ships at Taku and Tien-tsin without recourse to the lines of the Chinese Government.

WESTINGHOUSE RUSSIAN GIFT.—The text of the acknowledgment by the Empress of the gift of $5,000 by the Russian Westinghouse Company to her fund for the relief of the sick and wounded is as follows. It is signed by Count Rostovtsoff: "It has been a pleasure to her Majesty, the Empress Alexandra Feodorovna, to express her sincere thanks to the stockholders of the Westinghouse Company, consisting chiefly of citizens of the United States, who have placed $5,000 at her Imperial Majesty's disposal for the purpose of aiding the sick and wounded soldiers in the Far East, as well as for their expression of sympathy with Russia, which at the present time will have peculiar value. It is my pleasant duty to inform you of this by her Majesty's order."

THE YORK HAVEN POWER PLANT.—The officers and promoters of the York Haven Power Company are determined not to allow the damage which the recent freshet wrought to the extensive plant at York Haven to interfere with their original plan which was to have the plant in operation and supplying current to York and other towns by next May. At a meeting just held by the officers and the largest stockholders the reports of the damage were received. Plans were at once developed for the immediate repair of the plant. A temporary power house of wood is to be built over the machinery and a permanent brick structure will be reared over this. Repairs to the machinery can be made quickly and by the use of a temporary switchboard and the quick clearing away of the debris in the big race it will be possible to have the plant in operation within the next sixty days. The experts estimate that $10,000 will cover the cost of repair.

NEW YORK POOL ROOMS.—The Western Union Telegraph Company has been co-operating vigorously with the city authorities to stop business in the gambling pool rooms. It is said that Mayor McClellan's attention was directed to the controversy between the Western Union Telegraph Company and the several hundred pool rooms in this city—all of which the police declare are closed—the telegraph company having declared its ability, by withholding its service from the pool rooms, to put them all out of business, if certain leaks were not stopped. The Mayor was asked if it had occurred to his administration that by bringing pressure to bear on the telegraph company and compelling it to stop serving pool rooms it might do what the police admit they have great trouble in doing. "Do you mean," replied the Mayor, "that we should indict the officials of the Western Union Telegraph Company as accessories to the fact?" A moment later the Mayor, still thinking it over, said: "If the telegraph company carries out its threat to close the pool rooms, I guess the pool rooms will have to go to see brother Marconi."

TEXAS ELECTRICAL ASSOCIATIONS.—The Southwestern Gas, Electric and Street Railway Association and the Southwestern Electrical Association will hold a joint convention at Dallas, Texas, on April 25, 26 and 27. This will be the fifth annual convention of the former association, and the second convention of the latter. It is proposed to consolidate the two associations and the proposition will be voted upon at that time. Among the subjects to be discussed at the meetings will be: "Advantages of the Combination of Gas and Electric Light Plants"; "The Operation of Single-Phase Motors from the Central Station Standpoint"; "Framing of City Franchises for Public Service Corporations"; "Combination of Public Utilities in Small Cities"; "Economics of the Meter"; "Benefits and Evils of Telephone Competition"; "Accidents on Street Railways and Damage Suits"; "Central Station Accounting"; "Electricity and Risks"; "Requirements of the National Board of Underwriters in the Southwest," and "Developments of Interurban Railways in the Southwest." Mr. F. E. Scovill is secretary of the Southwestern Gas, Electric and Street Railway Association with headquarters at Austin, Texas.

THE NAME OF EDISON.—An article in *Cassier's Magazine* for April states that when Mr. J. Ricalton returned, in 1889, from a year's exploration tour in foreign climes, made in Edison's behalf in search of a suitable bamboo for filaments, he told how he had learned to regard Edison as the most widely known man in the world at that time. In all his journeyings in the Far East he had been astonished many times to find his name so familiar; even the unlettered natives of half-civilized countries had learned to associate it with the electric light. His donkey boy in the streets of Cairo was endeavoring, in broken English, to tell him something about the Khedive, when Mr. Ricalton asked him the name of the American Khedive. The boy shook his head to indicate that he did not know. Mr. Ricalton mentioned the name Harrison, who at that time was President of the United States, but the boy did not recognize it. Then Mr. Ricalton mentioned Edison's name: the boy smiled cognizantly and drawled the name, "Ed-ee-sone," while pointing to an electric light in front of the hotel. A few weeks later Mr. Ricalton mentioned the name to his courier in Morocco, whereupon the latter quickly proceeded to offer his knowledge of the man. Edison's name truly, Mr. Ricalton concluded, was a household word even at the ends of the world.

TEST OF COMMERCIAL AUTOMOBILES.—At the present time eighteen entries have been received by the Automobile Club of America for the service test of commercial motor vehicles which is to be held under the auspices of the club next week. There are eight classes according to the weight-carrying capacity. In the first class, including vehicles carrying 1,000 pounds or under, there are three entries, all being light gasoline delivery wagons. The second class has the largest number, nine vehicles, their carrying capacity limit being between 1,000 and 2,000 pounds. Of these nine the electrics are most numerous, five of the nine wagons being equipped with electric motors. Four of them are delivery wagons and one an express wagon. Of the other four, three are gasoline delivery wagons and one a steam delivery wagon. The third class, between 2,000 and 3,000 pounds, has two cars entered, both gasoline delivery wagons. The fourth class, between 3,000 and 4,000 pounds, has one, a gasoline truck. The fifth class, between 4,000 and 5,000 pounds, has one, an electric truck. No entries were made for the sixth and seventh classes, but in the eighth class, for vehicles carrying from 8,000 to 10,000 pounds, two heavy trucks are entered, one being a gasoline-electric truck and the other a steam truck. With the exception of the last class all the vehicles will perform the regular daily service of two local express companies, while the two big trucks will do the regular work required of the wagons in use by a large brewery. The club has engaged the services of a number of observers to assist in checking results.

LETTER TO THE EDITORS.

Cheap Current From Municipal Plants.

To the Editors of Electrical World and Engineer:

SIRS:—In your issue of March 19 Mr. C. W. Koiner, superintendent and chief electrician of the Madison County Gas & Electric Company, of Oneida, N. Y., takes exception to a statement made in my descriptive article relating to the South Norwalk municipal plant, published in your issue of February 20, regarding the rate of 1.9 cents per hp-hour by meter as charged by this plant for a consumption of say 50 hp-hours for 26 10-hour working days per month. I said in the article that there is no place known with the exception as given where power can be obtained so cheaply.

Mr. Koiner says that this statement is "erroneous" and "misleading," and that he "knows of cities and towns in his neighborhood that sell current for less than 1.9 cents per hp-hour." Assuming that the gentleman is familiar with his subject, I am willing to ac-

knowledge my ignorance in the presence of superior knowledge and humbly ask him to make good his assertion, by giving the names of the "cities and towns in his neighborhood" that make a business of selling electric power under the conditions and below the rate to which he takes exception. I believe that this information will be relished by the consumers of power in the places in mind, and further, that, as it is undoubtedly the aim of all good central station managers to give the greatest value possible, with due regard for profit, for the least cost of the consumer, such information would awaken a certain degree of professional curiosity as to the economies that make a lower rate possible.

The gentleman takes the opportunity, before concluding his remarks, with some seeming loss of dignity, to say disagreeable things about those who operate or advocate municipal central stations, from which it might be inferred that he is addicted to making extravagant assertions. I think that most of those who have to do with central stations (private or municipal) are a pretty good lot of people, and am glad to believe that I have many friends on both sides, among whom I would like to add the name of Mr. Koiner.

When visiting my old home not a great way from Oneida, it will be my pleasure to run in on Mr. Koiner, for a friendly call. I am thoroughly in accord with his sentiments regarding misstatements, only I would go a little further and say that "every misleading statement emanating from agitators" for or against "municipal ownership should be called to account." Both sides should be fair to each other and justice will follow. Private and municipal plants each have their place, and where one does right the other is not needed.

I see that my friend is faithful to his trust. I try to be the same to mine, and the question is not that I happen to be in charge of South Norwalk's municipal plant, but that I am here for results, without regard to who owns the plant, and incidentally I can look upon the good and bad of both private and municipal ownership with regret for the bad and joy for the good in each.

South Norwalk, Conn. A. E. Winchester.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Speed of Direct-Current and Induction Motors.—Hobart.—An illustrated paper read before the (Brit.) Inst. Elec. Engs. on the rated speed of electric motors as affecting the type to be employed. High speed is a very favorable condition for the continuous-current motor, but up to certain limits conduces to improve results for induction motors. The author gives a great many details on the design and behavior of direct-current and induction motors for varying speeds, and gives two comparative tables with all the dimensions, efficiencies, weights and costs for 150-hp continuous-current motors running at speeds between 68 and 1,224 and for 150-hp induction motors, operated at 21 cycles per second at synchronous speeds of 70, 210 and 630, or at a frequency of 63 cycles at synchronous speeds of 630, 940, 1,260 r.p.m. The principal conclusions at which he arrives are: Induction motors are for all capacities, considerably cheaper than continuous-current motors of equivalent ratings. The general performance and the mechanical construction of induction motors improve rapidly with increasing rated speeds. The general performance and the mechanical construction of continuous-current motors improve rapidly with decreasing rated speeds. The use of very low-speed induction motors and very high-speed continuous-current motors ought to be avoided whenever this is commercially practicable.—Lond. *Elec.*, March 11.

REFERENCES.

Magnetic Dispersion in Induction Motors.—Behn-Eschenburg.—A continuation of his paper. He shows that in the ordinary constructions of motors with open slots the part relatively contributed by the peripheral dispersion to the total values of the dispersion coefficient plays a very subordinate part. For closed slots, in which the iron bridge is made thin enough, this dispersion coefficient may be estimated about four times greater than for slots with slits. He then begins a general discussion of the winding coefficient. The paper is to be continued.—Lond. *Elec.*, March 11.

Alternators in Parallel.—Koehler.—An elementary article, illustrated by diagrams, in which the author discusses the fundamental principles of the operation of alternators in parallel, and describes the working of phase indicators.—*Elek. Anz.*, March 6.

Lights and Lighting.

Candle-Power and Temperature.—Eisler.—A paper in which the author refers to Lummer and Kurlbaum's determinations of the light given out by incandescent platinum at varying temperatures. They have developed an empirical formula which shows the rapid increase of candle-power with the increase of absolute temperature. This relation may also be found indirectly by means of calculation on the basis of Langley's figures for the sensibility of the eye in the different portions of the spectrum, and on the basis of the distribution of energy in the spectrum of an incandescent body. The author carries out this calculation and shows that the measurements of Langley and those of Lummer and Kurlbaum confirm each other, and that the following conclusions may be drawn with a certain degree of probability. The physiological action of combined light (that is, light of different wave lengths) equals the sum of the single actions of the light of the different wave lengths in it. The radiation of the theoretically "black" body differs from that of platinum in the visible part of the spectrum in absolute value, but both depend in exactly the same way upon the temperature. For both the black body and platinum there is the same relation in candle-power and temperature. The author criticises former attempts to give figures for the mechanical equivalent of light. Tumlirz, basing his conclusions on tests of the Hefner lamp, had stated that the visible radiation has the energy value of about 1,900,000 ergs per second. From this figure it follows that with no type of illumination would it be possible to get more than 5.2 cp per watt. The author shows that this conclusion is wrong since the physiological value of the visible radiation depends greatly on the temperature of the light. For about 4000° absolute temperature (arc light) this value is 3.5 times greater than for 1800° absolute temperature (Hefner candle). It would, therefore, follow that light corresponding to the composition of the spectrum of the black body at 4000° would give 18.7 candles per watt, if the efficiency was 100 per cent. If one desires to give a figure for the most ideal case of the generation of light, one might assume a process in which the energy is completely transformed into radiation of light of that wave length for which the human eye has the highest sensibility. For this special wave length one would get 65 candles per watt with an efficiency of 100 per cent. But such a light would not be practical, since a practical source of light should be of the same color composition as sunlight. For this case he gets a figure of 27 candles per watt for an efficiency of 100 per cent. In practice we will never attain this value, if some parts of the energy are transformed into invisible radiation and into other forms of energy which are not wanted. But even if by the use of phenomena of luminescence we should succeed in transforming the energy completely into visible radiation, there would be, nevertheless, a difference in the value of different sources of light according to the degree in which such "perfect" luminescent lights approach the spectrum of the sun.—*Elek. Zeit.*, March 10.

Photometric Tests of Street Lamps.—A table giving the results of comparative tests of street lamps extending over a period of 18 months. The tests were made by Bradley. The total cost per candle-power per year was found to be 21.5 c[illegible] ts and 17.46 cents for two sets of electric arcs with opalescent globes; 34.4 cents for electric arcs with muranese globes, 56.6 cents for refuge lanterns (4 mantels), 15.3 cents for Sugg's high-pressure gas lamps, 40 cents and 36.6 cents for two different sets of incandescent gas mantels, and 59.8 and 96.4 cents for two sets of triple flat-flame lamps. In the case of incandescent mantels, including high-pressure lamps, great variations in candle-power are found to be due to the condition of the mantels—what appears to the naked eye as a slight diminu-

tion in intensity, resulting in an enormous loss of candle-power. A slight defect in any of the incandescent mantels in high-pressure lamps causes a great loss of candle-power.—Lond. *Elec.*, March 11.

Traction.

Mersey Railway.—Kirker.—A paper read before the Manchester Section of the (British) Inst. Elec. Engs. Electric traction was inaugurated on May 3, 1903, arrangements having been made for an instantaneous and complete transformation. The steam traffic ceased on May 2, and electric traction, with a complete train service, began on the succeeding morning. The three-minute schedule has been successfully maintained from the beginning. The trains vary in size from two to five cars. In the three, four and five-car trains there are two motor cars, situated at the extremities. Multiple-unit control is used. The average electric load is 22,000 kw-hours per day. Concerning ventilation (which is important since the road is a tunnel road) he says that under steam conditions the average cost per half year exceeded $12,000; with electric traction it falls below $1,000 for a corresponding period. As to the schedule speed, the rate was 15 miles per hour for the steam trains and electric traction was laid out on the basis of 20 miles per hour, which is attained. With the steam locomotives the train mileage was less than 6,000 per week. During the last quarter of 1903 the electric trains lacked but 40 miles on an average of 15,000 miles per week. Concerning the coal consumption, it was estimated that the average would not exceed 4 pounds per kw-hour at the switchboard, and the average for the last quarter of 1903 and the first six week of this year is below 4 pounds. The consumption of energy for a loaded three-car train was estimated not to exceed 9.25 kw-hours per train mile; for the last quarter of 1903 the actual figure was less than 9. The cost of operation per train mile (including the power house expenses, the cost of power for operating and lighting trains, the maintenance of electrical equipments, cars and collector rails) was below 13.5 cents per train mile for an average train 230 ft. long, and weighing 105 tons, including motors. The corresponding cost per steam train, 200 ft. long and weighing 77 tons, exclusive of locomotive, but working at a schedule speed of 15 miles per hour instead of 20, exceeded 22 cents per train mile. The total power station cost did not exceed 0.7 cents per kw-hour during the last quarter of 1903.—Lond. *Elec. Rev.*, March 11.

Capacity of Traction Motors.—Müller.—An article in which the author describes a method for determining the size of a traction motor by calculation on the basis of tests of the heating of kindred motors. When used on the road, the motor assumes a certain end temperature which it maintains nearly constant throughout service. Under these conditions the heat which it gives out by radiation is equal to the heat produced by the electric current in the motor. This end temperature is required to be not over 75° C. over that of the surrounding air (in Germany). The total heat which is produced in the armature conductors is the sum of i^2t, where i is the current in the conductors at any time and t is a time element. The average iron loss is the sum of $Wt \div T$, where W represents the different iron losses during the different time elements, t and T, is the total time of a trip and return trip. If both the field and armature coils of a traction motor are tested at a series of voltages, for instance, 200, 300, 400, 500 volts, for continuous running at a temperature of 75° C. over the temperature of the surrounding air, then the watt represents that heat which the motor is able to give off at the iron losses which correspond to these voltages. One is, therefore, enabled to plot the capacity for continuous running as a function of the iron losses. A curve is thus obtained which, when once determined for the type of motor, is sufficient to determine the size of the motor for given conditions of service. Since a certain voltage corresponds to the determined average iron losses, one may say that the variations of load in the traction service may be represented by a continuous load, the current of which is given by the sum of $i^2t \div T$ and the voltage by the sum of $W t \div T$.—*Elek. Zeit.*, March 11.

Monorail.—A description of the model of Behr's monorail for the St. Louis Exposition. It is built on a scale of ¾ in. to the foot and comprises a circular track and a motor car running on it. Current is led to the car by means of two miniature rails running along each side of the track. This itself consists of a single running rail which is carried—in actual practice—a few feet above the ground, and of four guide rails which serve to steady the car in case it should tend to oscillate from any cause. The five track rails are carried by triangular supports of metal, the running rail being placed at the apex and the guide rails at the sides of the triangle. Owing to the mechanical difficulty of reducing the motors to scale, somewhat larger motors had to be installed and they are placed in the passenger compartment of the car. This in conjunction with the very sharp curves of the model track is said to account for the somewhat jerky and unsteady running.—Lond. *Elec.*, March 11.

References.

Electric Railways in Italy.—A note stating that on the Milan-Varese Railroad several trains have recently been equipped with the multiple-unit system and the results have been satisfactory. The continuation of this road from Varese to Luino, which is now operated by steam, will also be equipped for electric traction and three-phase motors will be used in this case. The line from Castle Raimonda to Camerino in central Italy is now being equipped electrically with the direct-current system. The road from Turin to Torre Pellice, of about 50 km. length, is to be changed to electric traction, and it is intended to use a single-phase system.—*Elek. Zeit.*, March 10.

Tramway Traffic.—Upton.—The first part of an article on through booking and conveyance of passengers, parcels and merchandise on tramways and light railways.—Lond. *Elec. Rev.*, March 11.

Installations, Systems and Appliances.

Hackney Station.—The first part of an illustrated description of the Electricity Works and Destructor Plant of the Metropolitan Borough of Hackney. The supply is on the direct-current system at 40 volts, and from the commencement flat rates of 8 cents for lighting and 4 cents for power have been charged for electrical energy. The plant began working in 1901 with a capacity of 1,800 kw, which has already been increased to 3,372 kw. The refuse destructor consists of 12 cells, each group of four cells being designed to deal with 60 tons of refuse per day. The generating plant consists of two 250-kw sets, two 300-kw sets and one 1,500-kw generator, all driven by vertical triple-expansion enclosed high-speed engines, provided with condensing plant. In addition there is a booster of 50 kw driven by a motor.—Lond. *Elec. Rev.*, March 11.

Reference.

1,000-kw Double-Current Turbine Generator.—An abstract of a specification for a 1,000-kw, double-current generator for the Stepney Electricity Works. It consists of a steam turbine coupled to two 500-kw double-current generators in tandem on an extension of the turbine shaft. Each machine is shunt wound and multipolar and provided with a commutator and three slip rings, the frequency of the three-phase currents being 40 to 60 periods per second.—Lond. *Elec.*, March 11.

Electro-Physics and Magnetism.

N-Rays.—In order to disprove the assertion that the effect of N-rays is purely subjective, Blondlot has made experiments in photographic registration of the effect of these rays upon a small electric spark. In all the 40 experiments made only one was unsuccessful, while all others showed a distinct effect of the N-rays. Ballet has used N-rays successfully in order to diagnose some diseases of the nervous system; there is a diminution in the emission of N-rays in paralyzed or atrophied muscles in myopathic and other cases. Charpentier and Meyer have found that the intoxication and curarization of certain nerves produces a perceptible effect upon the radiation of N-rays by the muscles which they control. Jegou has found that any wire carrying an electric current emits N-rays; a simple means of obtaining N-rays is to take a Leclanche cell and to close the circuit for some time. The N-rays are stored in the liquid, which becomes a powerful source of the same.—*Comptes Rendus,* February 22; Lond. *Elec.*, March 11.

N-Rays.—Blondlot.—An account of an experimental investigation of the dispersion of N-rays and a measurement of their wave lengths. A beam of N-rays, when subjected to dispersion by means of an aluminum prism, is dissolved into several beams corresponding to different indices of refraction. The wave lengths of the N-rays were found to be much shorter than those of light.—*Comptes Rendus,* January 18; translated in Lond. *Elec.*, March 11.

Stresses in a Magnetostatic Field.—Walker.—A (Brit.) Physical Society paper referring to the observation made by Quincke that when a glass bulb containing a solution of ferric chloride was placed between the poles of a strong electromagnet, the level of the liquid, in a capillary attached to the bulb, fell. This has generally been

held to require for its explanation a system of stress which differs from the magnetic stresses of electrical type. The present author endeavors to show that the experiments can be quite well explained by the stresses of the electrical type.—Lond. *Elec.*, March 11.

REFERENCES.

Resistance and Temperature.—KÖNIG.—An article giving the simple formulas for calculating the change of electric resistance with temperature. He also gives a simple diagram which enables one to quickly read of the temperature variations of copper resistances. —*Elek. Anz.*, March 3.

Radium.—DANNE.—The first of a series of articles on radium salts; the present portion deals with their preparation and properties, some interesting illustrations being given.—*La Nature*, March 5.

ELECTRO-CHEMISTRY AND BATTERIES.

Ferro-Nickel from Pyrrhotite.—SJOESTEDT.—An illustrated account of experiments made at Sault Ste. Marie on the production of ferro-nickel direct from the Sudbury nickeliferous pyrrhotite. Experiments were made to subject the roasted fines to electric smelting and an electric furnace was erected for this purpose, in which a ferro-nickel pig iron was made from a poor roasted pyrrhotite, with about 3 per cent. sulphur and 53 per cent. iron, at the rate of 60 pounds per hour, with an electrical energy of 108 kw. This is equivalent to 225 gross tons per year, corresponding to an expenditure of 230 hp per ton-day. With a furnace of 300 to 500 hp, which would be more economical, 180 to 200 hp would probably suffice for obtaining a gross ton of metal. But even at that rate the intended plant for the manufacture of 50 tons of ferro-nickel pig per day would have required an electric installation of 10,000 hp, which meant more time and expenditure than were considered necessary. It was, therefore, decided to dead roast the ore, briquette the roasted fines and convert the briquettes, together with an addition of non-nickeliferous iron ores, by the ordinary blast furnace process, into a pig of desired nickel contents.—*Iron Age*, February 13.

Electro-Analysis.—HOLLARD.—A Faraday Society paper on some applications of the theory of electrolysis to the separation of metals from one another. He discusses three different principles and gives examples of their particular application. The first is to reduce the resistance of the bath by suppressing the formation of gas at the anode, either by introducing a reducing agent at the anode or by the use of a soluble anode. As an application the separation of zinc from nickel is discussed. The second method is based on the use of a metal for the cathode which prevents the liberation of hydrogen since it has a higher overvoltage for the production of hydrogen than other metals. The third method consists in preventing a certain number of metals from precipitating themselves upon the cathode by bringing them into the state of complex salts, the separation of antimony and tin in a concentrated solution of sodium hydrogen sulphide being an example of this principle.—Lond. *Elec.*, March 11.

Electrochemical Developments.—BLOUNT.—The first of the series of Cantor lectures. He stated that the electrochemical industries appear at present to pass through a transition stage. Of those processes which are already of practical utility, copper refining is the most important. Competition between chemical and electrochemical manufacturers is extremely beneficial, since it tends to stimulate workers in both fields to further exertion. As a result, any electrochemical process for using substances which can also be produced chemically is in a more flourishing condition than one which forms the sole basis of manufacture. Pure carbonates can only be produced electrolytically and, therefore, this particular branch is not in quite so healthy a condition as it might be. For copper refining, he believes the multiple system to be better than the series system, although much depends upon convenience. To make a process commercially successful it is necessary to employ a high rate of deposition. In the Dolphin plant good circulation is effected together with the free admixtures of air with the electrolyte, and a current density of 25 amp. per square foot is used. For producing zinc electrolytically, he considers the prospects of obtaining it from a fused salt as good. "The electrolytic winning of lead he considers as absolutely hopeless; while the winning of zinc might be large, but the refining, never."—Lond. *Elec.*, March 11.

REFERENCE.

Concentrated Solutions.—JONES AND GETMAN.—A long account of an experimental study of the molecular lowering of the freezing point of water produced by concentrated solutions of electrolytes. The authors find that, with but few exceptions, electrolytes in general give abnormal molecular depressions of the freezing point in concentrated solutions. They conclude that in concentrated solutions there is combination between the molecules of the dissolved substance and the molecules of the solvent, thus removing a part of the solvent, as far as freezing point lowering is concerned. To explain the conductivity result it is also necessary to assume that there is a certain amount of electrolytic dissociation, together with the hydration, existing in these solutions.—*Phys. Rev.*, March.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Determining the Coefficient of Mutual Induction.—TROWBRIDGE.—A description of a very simple method of determining the coefficient of mutual induction. It is based on the following principle: Two coils of mutual inductance, M, and of self-inductances, L_1 and L_2, when joined in series with the windings in the same direction are equivalent to a single coil of a self-inductance, $L' = L_1 + L_2 + 2M$. When the coils are joined in series so that the lines of force from one oppose the lines from the other, the system is equivalent to a single self-inductance, $L'' = L_1 + L_2 - 2M$. The two coils (provided with a commutator for reversing the direction of the current through one of them) may be put in one branch of a Wheatstone bridge, the other branches of which consist of two non-inductive resistances and a variable standard of self-induction. A balance for steady currents and for variable currents being obtained when the currents are in the same direction through the two-coil gives L'. Repeating the balancing, when the currents are in opposite direction, gives L''. Thus we get M directly as one-fourth the difference between L' and L''. This method, which is very exact, depends on the availability of a variable standard of self-induction. If such a standard is not available, the determination of M may be effected as follows. A coil of a self-inductance L (preferably intermediate between L' and L'') is prepared and by the bridge method the ratios of L' to L and of L'' to L may be found—calling these p and q, respectively, M becomes $\frac{1}{4} L (p - q)$. If L be determined by balancing against electrostatic capacity, then M may be calculated, since p and q are numerical expressions obtained by the use of the bridge. —*Phys. Rev.*, March.

Magnetograph.—WATSON.—A (Brit.) Physical Society paper in which he describes an instrument resembling in principle the Threlfall quartz-thread gravity balance. The principle is to have a magnet suspended on a horizontal quartz fibre kept stretched by means of a spring. The center of gravity of the magnet and the torsion of the fibre are so adjusted that the axis of the magnet is always horizontal. Any variation of the vertical force produces a rotation of the magnet about the fibre, which can be suitably recorded by means of a mirror attached to the magnet. The temperature compensation is effected by weighing the magnet on the same side of the axis of the fibre as the south pole, so that the magnetic couple and the couple due to the torsion of the fibre act in the same direction. Hence, since an increase in temperature causes one of these doubles to decrease and the other to increase, by suitably adjusting the weight and, therefore, the magnitude of the torsion couple, complete compensation can be obtained.—Lond. *Elec.*, March 11.

Electro-Thermometer.—CALLENDAR.—An account of his second lecture on electrical methods of measuring temperatures, the first lecture having been abstracted in the Digest last week. One of the physical problems which can be solved by the application of the electric thermometer is the determination of the absolute expansion of mercury; although this has been done previously, the results require verification, and the author intends to carry out investigations in this direction, using a mercury column 60 ft. long in conjunction with a platinum resistance thermometer. For determining the expansion of various other materials with the temperature, the electrical methods are likewise very convenient; also for determining the latent heat of solutions, for measuring the specific heat of water and steam, for observing the lowering of the freezing point of ice under pressure, and for determining the temperature of steam at different pressures, etc.—Lond. *Elec.*, March 11. A very complete illustrated account of the first lecture of Callendar is given in Lond. *Eng'ing*, March 4.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Type-Printing Telegraph.—SIEMENS.—A very long illustrated paper read before the Berlin Electrical Society on the new high-speed

type-printing telegraph of the Siemens & Halske Company. The type printing is done by a photographic method, as shown in Fig. 1. On the rim of the type wheel the 45 different letters and types are cut out at uniform distances on the periphery. This type wheel revolves between an electric spark-gap, *F*, and a sensible strip of paper, *P*. If a certain letter is between the spark-gap and the sensible paper, the arc will send its light through the letter, which

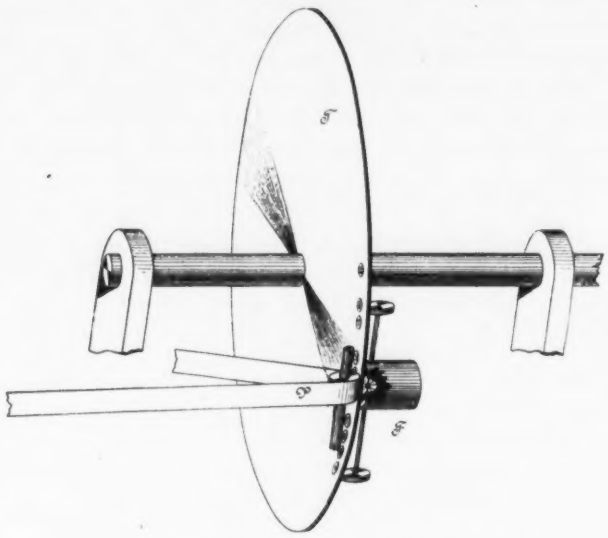
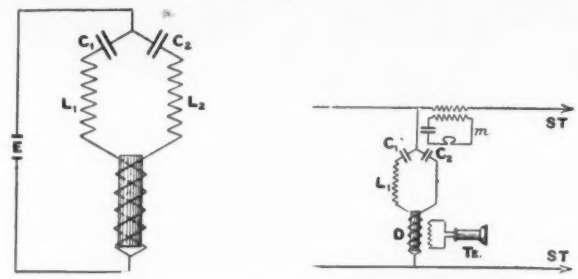


FIG. 1.—TYPE PRINTING TELEGRAPH.

is cut out in the wheel, and the letter will be printed on the paper strip. Since the time of the electric spark is smaller than one-millionth second, the paper strip can be moved at practically any speed without distorting the letter. The receiver and transmitter are operated as two apparatus always revolving in exact synchronism at a speed up to 2,000 r.p.m., or even more. In every revolution one letter may be printed so that 2,000 letters can be transmitted per minute. For every letter transmitted, the transmitter has to send out two current impulses, one positive and one negative, which act on a relay in the receiving station. By the negative impulses one of nine group condensers of the receiving apparatus is charged, while by the positive impulses the condenser is discharged at that place which corresponds to the desired letter. The apparatus is described in detail and profusely illustrated.—*Elek. Zeit.*, March 10.

Simultaneous Telegraphy and Telephony.—BRUNE AND TURCHI.—A description of an instrument called a separator, by means of which any existing telephone circuit, whether using earth return or metallic return, can be utilized for simultaneous telegraphic and telephonic messages. The separator is constructed on the principle illustrated in Fig. 2, where *E* is the source of alternating current



FIGS. 2 AND 3.—SIMULTANEOUS TELEGRAPHY AND TELEPHONY.

and the circuit divides itself into two branches of inductances, *R*, and capacities, *C*. If this circuit is traversed simultaneously by two superimposed sine currents of different frequencies and the constants of the circuit are so regulated that there exists a certain relation between the one frequency and the inductances and capacities, then only the current of the other frequency will give rise in the core to a resultant flux, differing from zero, and the effects of the two currents are thus separated. Fig. 3 illustrates the manner in which this system would be utilized for sending one telephonic and two telegraphic communications simultaneously over the same metallic telephone line, *m* being the microphone, *Te* the telephone and *St* the telegraphic station.—*Nuovo Cimento*, October, 1903; abstracted in Lond. *Elec.*, March 11.

Telephony in Great Britain.—A long editorial stating that there are indications that the telephone industry in Great Britain is approaching a crisis. There are at present governmental, municipal and private company telephone systems, but up to the present telephony has not been one of the most successful industries in England; some of those who are carrying it on are doing so at a loss, while others are just making it pay its way. The reason is thought to be that those connected with telephony feel that its present basis is not sufficiently firm. The position of competing telephone concerns must necessarily be insecure, for telephony is, in the nature of things, a business in which competition cannot continue to exist.—Lond. *Elec.*, March 11.

REFERENCE.

Wireless Telegraphy.—MEES.—An elementary and very clear description of the fundamental principles on which wireless telegraphy is based. The action of electric waves is explained by means of the analogy with a tuning fork.—*Rose Technic*, March.

New Books.

COURS D'ELECTRICITÉ. By H. Pellat. Paris: Gauthier-Villars. 2 volumes. Vol. I, 329 pages, 145 illustrations; price, 10 francs. Vol. II, 522 pages, 221 illustrations; price, 28 francs.

These volumes treat successively of most of the essential subjects in an academic course of electricity; the outstanding matters of electrolysis, electro-capillarity and kindred phenomena will be dealt with in a forthcoming volume. It is evident that M. Pellat's audience at the Sorbonne consisted more of men already familiar with the subject and anxious to hear it expounded by a recognized authority, rather than of ordinary college students looking for the usual sequence of subjects with its strict didactic form and goodly array of mathematical symbols.

M. Pellat is always very lucid in his exposition even of the more recondite phenomena; he also makes a good defence of his somewhat radical departure from the time-honored orthodox mode of treatment. Thus, at the very outset, he admits the importance of Coulomb's law, but declines to use it as the basis of his treatise on electrostatics because of its inapplicability to heterogeneous media. As usually written, the law of force is $F = \frac{1}{K} q_1 q_2$. The constant, *K*, shows that the medium must be homogeneous; for, if not, the force may not act along the line joining the two point charges and may not vary as the inverse square of the distance.

Again, we find the opening chapter of Vol. II devoted to electrodynamics, whilst permanent magnets, electromagnetism and electromagnetic induction follow later on. The reasons assigned for this inversion of customary order are that it tends to simplify calculations, leads to a shorter mode of treatment, and, above all, shows up the real meaning of what is called "quantity of magnetism," which the author emphatically holds to be a mere mathematical concept corresponding to nothing real in nature.

One likes such passages as: "The idea of a force existing between two bodies at a distance from each other without an intermediary is too repugnant to common sense to be admitted." "Newton did not say that the heavenly bodies attract each other, but that "everything takes place as though they do." Gilbert's *De Magnete* is spoken of as "a remarkable work on the mutual action of magnets." Boyle is credited with the introduction into scientific nomenclature of the term *electricity*, whereas it was first used by Charleton in his *Ternary of Paradoxes*[1], page 97, published in 1650, when Boyle was in his 24th year. Previous to the coinage of the term by Charleton, the adjective form was in use; thus, we had a *motus electricus, vis electrica, corpora electrica*, and the like.

Our author attributes the discovery of the Leyden jar to Dean von Kleist and takes care to note that it was due to a mere accident; further on he adds that it was rediscovered in a similar haphazard way by young Cunæus while working in the laboratory of Van Musschenbroeck in the University of Leyden. Though this is by no means improbable, yet the good luck of Cunæus has often been discredited.

The principle of the electrophorus is ascribed to Wilcke, of Stock-

[1] See Wheeler Collection in the Library of the American Institute of Electrical Engineers.

holm, in 1762; but the apparatus, as we have it to-day, is unquestionably Volta's, belonging to the year 1775.[2]

A few omissions occur in the development of the old frictional machine, which, if supplied, the following would be the main points in its evolution: The original globe of sulphur of Von Guericke was replaced by one of glass by Hauksbee. In turn, this was changed for a glass cylinder by Gordon, a Scotch Benedictine monk, then professor at Erfurt, Germany, while Winckler, of Leipsig, substituted a leather cushion as a rubber in lieu of the hand of the operator. Canton improved the action of the rubber by covering it with an amalgam of tin and mercury. Sigaud de la Fond had a plate machine constructed in 1756, which was greatly improved some years later by Ramsden, of London.

Much space is given to the theory and operation of the Holtz machine, a few paragraphs only being devoted to the Wimshurst, which, invented in 1881, is now rapidly replacing its famous prototype.[3]

The Wimshurst machine is rightly said to be practically independent of all atmospheric conditions, to which priceless advantage the author might have added two others, viz.: that it is always self-exciting when the contacts are clean, as they ought always to be; and that it never indulges in the provoking idiosyncrasy of changing its polarity during a lecture.

As to its reversibility, the late Mr. Wimshurst was in the habit of illustrating this essential feature of influence machines to his friends in his laboratory on Clapham Common, London, by sending the current from one of the larger machines into a very small one, which then acted as a motor and did so very satisfactorily. It would be interesting to know if the statement one sometimes hears is really true, viz.: that the current from, say, a 20-in. Holtz or Wimshurst machine will drive one of similar dimensions as a motor.

Electrical readers are aware that M. Pellat has done excellent work in determining the dielectric constant (K) of paraffine and ebonite; Vol. I, Chapter IX, contains an account of his method and of the apparatus which he used.

In Vol. II we notice with pleasure a description of the elegant method introduced by our own Steinmetz for determining the intensity of the current in alternating circuits; it is a well-deserved tribute to American talent and originality.

Only brief reference is made to the discoveries in radioactivity by Becquerel and the Curies. The fractionization of the atom by J. J. Thomson and the electronic theory of Lodge are not even mentioned; such reticence may, however, be overlooked in view of the author's eloquent insistence throughout on the grand, fruitful work of Clerk Maxwell.

"Annuaire" for the year 1904. Published by the Bureau des Longitudes. Paris: Gauthier-Villars. 850 pages, illustrated. Price, 1.50 francs.

This little volume appears for the first time in divided form. Hitherto it has contained not only astronomical, physical and chemical tables, but also geographical and statistical tables. The yearly increasing matter in every department has rendered it necessary to publish these two divisions of tables on alternate years. This year the astronomical, physical and chemical tables appear.

It is wonderful how much matter is condensed into so small a volume. The first hundred pages relate to calendars. The Gregorian, Russian, Jewish, Mussulman, Roman, Chinese and French Republican calendars are all given. Then follow a number of astronomical tables, occupying 250 pages. More than 300 pages are devoted to condensed tables of densities, specific heats, elasticities and other physical and chemical data.

At the end of the book are two interesting special chapters. They relate respectively to the results of the International Geodetic Conference, held at Copenhagen in August, 1903, and to an elementary explanation of the phenomena of the tides. Electric units receive a special chapter from M. Cornu. The terrestrial magnetic elements for a number of towns and cities in France are also tabularly stated. At Paris, for example, on the 1st of January, 1904, the horizontal intensity is given as 0.1984 gauss, the dip 64° 44′ and the declination as 14° 36′ W.

The tables of the book are very valuable, not merely because they are in clear and compact form, but also because they are official, and represent the data accepted by the French Government. An official value of a quantity is often a very useful one, altogether apart from the question of relative accuracy.

The book is naturally not free from errors of oversight. For example, in defining longitudinal extension, an area is expressed in millimeters, where clearly square millimeters is understood. But the authors are to be congratulated upon the great compactness and extensiveness of the data set forth.

[2] Volta's condensing electroscope was destroyed in the fire at Como in 1899; one of his "piles" was saved.

[3] James Wimshurst was born in London in 1832, where he died on January 3, 1903. In 1898 he was elected Fellow of the Royal Society.

BOOKS RECEIVED.

La Telegraphie Sans Fil. By E Guarini. Bruxelles: Ranlot. 64 pages, 88 illustrations. Price, 2.50 francs.

Electric Toy Making. By T. O'Conor Sloane. New York: Norman W. Henley & Co. 183 pages, illustrated. Price, $1.00.

Electrochimica. Soda Caustica, Eloro e Clorati Alcalini per Elettrolisi. Ing. F. Villani. Milan: Ulrico Hoepli. Price, 3.50 lire.

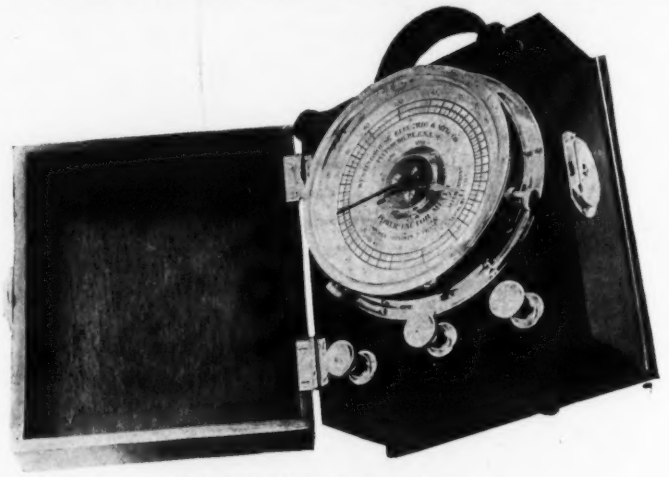
Die Elektrometallurgie der Alkalimetalle. By H. Becker. Halle: Wilhelm Knapp. 128 pages, 83 illustrations. Price, 6 marks.

Electric Lighting and Power Distribution. Vol. II. By W. Perren Maycock. London: Whittaker & Co. 690 pages, 407 illustrations. Price, 7s. 6d.

Dizionario Tecnico in Quattro Lingue. II. Tedesco, Italiano, Francese, Inglese. 2 Edizione. Ing., Edoardo Webber. Milan: Ulrico Hoepli. 611 pages. Price, 6 lire.

New Portable Power-Factor Meter.

The ordinary method of ascertaining the power factor of a polyphase circuit by means of a comparison of the output in watts with the indicated volt-amperes—a quantity obtained by the multiplication of the indicated voltage by the indicated ampere output—is open to serious criticism. In addition to the tedium and inconvenience involved in making three observations, a multiplication and a division, there is an evident liability to error caused by the number of operations required to obtain the result, which is increased by the fact that readings are taken successively and not at the same instant.



PORTABLE POWER-FACTOR METER.

The inaccuracy of such a method is demonstrated by the fact that by its use there may be shown a power factor of over 100 per cent.

It has been found possible to avoid errors and to simplify the process of determining the power factor of a polyphase circuit by employing a single instrument which indicates directly upon a scale the power factor of a circuit, which reproduces on the dial by the position of a pointer, the angle of phase difference, and gives the actual power in percentage of the apparent power. Such an instrument made in suitable form for testing purposes is shown in the accompanying illustration of a new portable power factor meter made by the Westinghouse Electric & Manufacturing Company. It operates with equal facility and accuracy on either a leading or lagging current, and indicates whether the current leads or lags, whether power is delivered to or by the circuit, and the power factor.

In principle it consists of two sets of coils, one of which contains a separate series winding for each of the phases in the circuit, and the other a potential winding which is connected across one phase of the circuit. The series coils are so arranged as to produce a resultant rotating field. A small iron vane passing through the poten-

tial winding forms movable pole pieces for this winding, which take up a position in the rotating field depending upon the phase relation of the currents producing this field and the voltage impressed upon the potential winding. The pointer attached to the shaft carrying the movable vane indicates on a scale the angle between the current and the voltage, the scale being so graduated as to read directly in power factor. Should the power factor of the different phases differ from each other, the instrument will indicate the average power factor.

Different instruments are provided for two and three-phase circuits. They are made with the same care and accuracy that is employed in the manufacture of the other Westinghouse testing instruments, are finely finished and provided with covers which are made removable for convenience in use.

Another Large Concern to Build Steam Turbines.

Another large engine building concern is entering the turbine field, the Hooven-Owens-Renschler Company, makers of the Hamilton Corliss engine at Hamilton, Ohio, having so decided. A 1500-kw horizontal turbine is now under construction at the company's extensive shops. It is intended to exhibit this machine at the St. Louis World's Fair.

A 600-hp compound condensing Hamilton Corliss engine has been ordered by the Bayshore Terminal Company of Norfolk, Va. It will be direct connected to a direct-current Westinghouse generator of 400-kw capacity. An engine of similar capacity is also to be installed on the New York and Hudson River Railway and Ferry Company at Edgewater, N. J. The generator will also be of Westinghouse build. A 300-hp engine has been requisitioned by the Chambersburg and Gettysburg Electric Railway Company, of Chambersburg, Pa. This will be a belted machine.

Electromagnetic Track Brake.

A new electromagnetic brake has been developed by the British Thomson-Houston Company, which we illustrate herewith. The brake consists of a cast-steel shoe suspended from a bracket fastened to the side of the car truck. This bracket is well ribbed and braced, and provided with heavy lugs, which take the thrust of the brake through cast-steel links in compression. The bracket is formed to act as the seat for two compression springs, which support the brake proper by wrought-iron eye-bolts. These springs keep the brake-shoe free from the track when it is not in operation.

The brake-shoe itself consists of a heavy steel casting with a cored recess, into which the magnetizing coil, which is energized by current from the motors acting as generators, is placed. A brass cap or cover is placed over this coil, and so fitted as to form a water-tight protection to the coil. A steel core extends through the coil providing magnetic circuits, which are completed by sections of rail under the end of the coil.

The terminals of the magnetizing coil consist of insulated flexible wires, brought out through bushed holes in the top of the cast-steel frame of the shoe. They consist of two wires in duplicate, and are

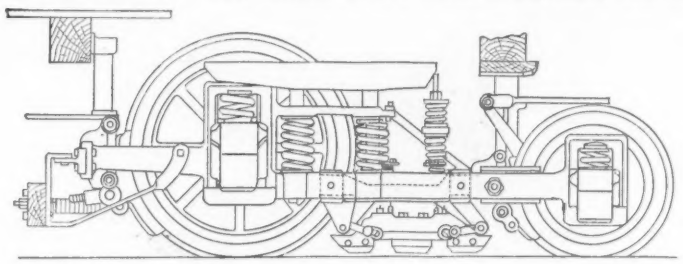


FIG. 1.—DIAGRAM OF TRACK BRAKE.

of sufficient length to extend from the end of the coil winding to the car underframing without a joint.

Each shoe is provided with wearing plates for contact with the rails. These plates are steel castings, held in place by machined bolts, so placed that the plates may be renewed without removing the brake-shoe from the truck.

The brake has been developed in two different forms. The first consists of a large shoe with a bracket designed to suit the various types of single trucks. Two shoes of this type constitute a set, the windings being connected in parallel. This insures protection against failure due to an open circuit. The second is designed for double-truck cars, four shoes per car constituting a set, one shoe being attached to each side frame of each truck. The operating coils of the two shoes on one bogie truck are placed in series, and these are placed in parallel with the two on the other bogie truck. Thus in case of injury to any one shoe or coil only half of the braking effort of the car would be rendered inoperative.

Following are the results of some tests made with the brake, which were carried out under actual working conditions on one of the

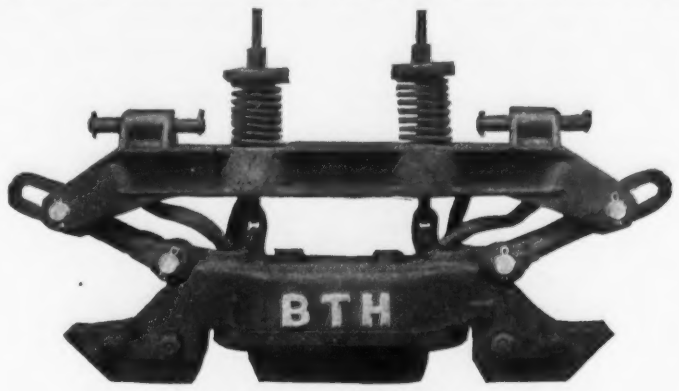


FIG. 2.—TRACK BRAKE.

heaviest routes in England. A four-wheel, double-deck car, with two motors, was used, with the following results on emergency stops:

Speed on applying brake.	Time to stop.	Distance to stop.	Grade Down.
25 m. p. h.	4 seconds	25 yards	1 in 13
14 m. p. h.	1.6 "	5.3 " Level	1 in 14

The first test represents extreme conditions, such as a car running down a steep incline, and considering the grade and the high speed the stop was very rapid, being made in about two and one-half car lengths. The second test would correspond to the case of a car traveling at a moderate speed and obliged to pull up suddenly; it will be seen that such a stop can be made in less than a car length.

SPEED REGULATION DESCENDING GRADES.

Speed maintained.	Grade.	Current per motor.
5 m. p. h.	1 in 13	4 amps.
	1 in 14	
5 m. p. h.	1 in 17	3.5 "
5 m. p. h.	1 in 45	2 "

The second table is interesting inasmuch as it shows that a low and even speed can be maintained when the car is coasting down the steepest grades, so that it is always under perfect control. If necessary the car can be brought to a stop by further movement of the controller handle and held at rest by the wheel brake.

Hauling-in Heavy Cables.

The Knickerbocker Construction Company, 15 Cortlandt Street, New York, has acquired the right to use the Grinnell patent hauling machine and all the devices connected with it. The principal feature of this machine is a chute or guide for the hauling rope, which is connected with the hauling machine extending to the opening at the duct. The rope coming from this guide goes around sheaves on the machine, which insures a perfectly uniform pull entirely regulated by the man operating and without any of the surge usual on capstan and windlass work.

By this arrangement any obstruction in the duct can be felt by the man operating as readily as if he was pulling directly by hand. When the end of the cable reaches the manhole, pulling is continued around the chute without making a separate hitch on the cable until sufficient is in the manhole for splicing purposes. The pull while perfectly uniform can be instantly regulated from nothing to a speed of 40 ft. per minute on the ordinary heavy cables.

By the use of this machine the work can be accomplished rapidly without any chance of injury to the cable. By the continuation of the method of hauling into the manhole and carrying the cable up around the large sheaves of the machine, cables can be hauled out without injury to them and placed on the reels ready for hauling in elsewhere. On the smaller machines gasoline engines are used, and on the larger ones steam engines.

English Portable Testing Set.

The demand for a testing set suitable for use in an engine room and one that can be placed anywhere and be free from the danger of erroneous readings resulting from stray fields, led Nalder Bros. & Thompson, Limited, of London, to produce the instrument illustrated herewith. The instrument is of the moving coil type, and is dead beat. It is fitted with a white enamelled metal scale and a metal mirror. The screening of the instrument has received very careful attention, and is stated to be so efficacious that it is almost impossible for the reading to be affected, even if it be placed quite close to a dynamo or motor.

The voltmeter resistances are carried in the instrument itself, and

PORTABLE TESTING SET.

the current shunts in a separate case. Measurements up to 1,500 amp. and 600 volts can be made, and, as a double-pole change-over switch is provided, resistances can be measured by the practically simultaneous observation of current potential difference. The pressure required to deflect the pointer to the top of the scale on the ammeter side (terminals *AA*) is .12 volts, and, as the scale is divided into 120 divisions, each division corresponds to .001 volt, so that the fall of volts on rail joints, etc., can be tested conveniently. The current shunts are of a new design, and very convenient for connecting, in addition to which they are light. A complete set up to 600 amp. can be carried in quite a small box.

Oil Circuit Breakers.

The use of circuit-breakers as a means of protecting the car equipment from dangerous overloads has become quite general and has led to the development of several different types of breakers designed especially for this class of service. The oil car circuit-breaker shown in the accompanying cut, manufactured by the Hartman Circuit-Breaker Company, of Mansfield, Ohio, is designed to take the place of the fuse block and hood switch on the car. It automatically opens the circuit in case of overload or short-circuit and it can be operated by hand as readily as the usual hood switch.

The switch and current-carrying parts are immersed in oil within a tight cast-iron case. The feature of oil insulation permits of more compact and simple construction than is possible with the usual magnetic blow-out type. The distinctive feature of the circuit-breaker, however, is the use of a series break, consisting of five double-break plug contacts connected in such manner as to give ten breaks in series. The circuit is broken simultaneously at ten distinct points, and the break taking place in oil there is absolutely no destructive arcing, and the circuit-breaker will open quickly and safely on the severest overloads.

The operating mechanism is very simple and consists of a vertical rod, to the lower end of which are attached the movable bridging contacts. The rod operates in a brass bearing and is controlled by a toggle. A slight turn of the handle will cause the toggle to straighten out, thus raising the contact rod and effecting the closing and locking of the switch. The tripping coil is immersed in oil within the case, and, when an overload occurs, the plunger or core operating within the brass tube of the solenoid delivers a strong hammer blow against an extension of the lower joint of the toggle, throwing the toggle out of center and effecting the opening of the switch. Ample space is provided between the live parts of the switch and the cast-iron case, and, as an additional precaution against grounding, the case is lined with insulating cement. Connection to the outside circuit is made within the case by means of insulated cables.

While the circuit-breaker was primarily designed for car service it is also well adapted for switchboard use. It is usually placed on the back of the panel with the handle rod projecting through

CIRCUIT BREAKER.

the board, and the circuit-breaker is opened or closed by hand from the front of the board. The circuit-breaker is also especially well adapted for the protection of motors in mills and factories, for the reason that it is not affected by damp and dirty locations, and there being no exposed current-carrying parts, the circuit-breaker is never a source of danger to those who may be working in the vicinity.

Mine Locomotive.

The accompanying illustration shows an electric locomotive for mine and tunnel work recently designed by the Electric Construction Company, of London, and Wolverhampton, England. Owing to the space limitations in this class of work machines to be adapted to the conditions must be small and compact. In this particular instance

MINE LOCOMOTIVE.

the locomotives were specified not to exceed 3 ft. in width, 3 ft. 4 in. in height, as the tunnel is only 6 ft. high at its maximum point.

The total weight of a complete locomotive of this type is about 4½ tons. It is capable of hauling a load of 35 tons at a speed of 5 miles to 6 miles an hour, but when running light it can attain 10 miles an hour. It is fitted with two motors, each having a normal capacity of about 12½ hp. They can be controlled from either end. Ordinary hand brakes and also emergency brakes are provided.

Power is conveyed to and from the locomotive by two overhead wires.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—There was considerable activity in the stock market and strength in prices on the announcements regarding the practical winding up of the Northern Securities Company. This naturally affected the rest of the list to a greater or less extent. Later in the week some uncertainty seemed to prevail as to the distribution of the Northern Securities' assets so far as its holdings in Northern Pacific and Great Northern were concerned, the effect of which was to cause a rather sharp decline in prices throughout the list. On Friday, however, the market recovered its tone and there was a renewed advance. Excepting these stocks there were no important developments. There was more or less renewed bullish manipulation in Amalgamated Copper. Among the industrial stocks the most important change was that in Allis-Chalmers preferred, the result of the week's trading being a net loss of 10½ points, the closing quotation being also the lowest, namely, 39½. This stock touched 48 during the week. The common stock closed at the highest figure of the week—8⅜—this being a net gain of ⅜ point. General Electric made a net gain of two points, closing at 166, ex-div., while Westinghouse common lost 1½ points, closing at 161½, which was also the lowest price of the week, the highest being 166. In the traction list there was considerable activity in trading in Brooklyn Rapid Transit, the total number of shares dealt in being 142,360. This stock fluctuated between 42¾ and 44¾, closing at 43¼, this being a net loss of ⅝ point. Metropolitan Street Railway was also active as to trading, 35,475 shares being sold at prices ranging between 110 and 113¼, the closing quotation being 111, ex-div., this being a net gain of one point. Western Union kept quite steady throughout the week, closing at 88¼, this being a gain of ⅛ point. On the curb there was a fair demand for investment issues, with generally higher prices for the entire list. Following are the closing quotations of March 29:

NEW YORK.

	Mar. 22	Mar. 29		Mar. 15	Mar. 29
Allis-Chalmers Co.	6⅛	7⅛	Electric Vehicle	7	6⅛
Allis-Chalmers Co. pfd.	39¾	40	Electric Vehicle pfd.	10	10
American Tel. & Cable	84	84	General Electric	168	165
American Tel. & Tel.	124	124	Hudson River Tel.	..	..
American Dist. Tel	22	23	Metropolitan St. Ry.	112⅛	111¾
Brooklyn Rapid Transit	43	43⅝	N. Y. & N. J. Tel.	..	..
Commercial Cable	176	173	Marconi Tel.	..	..
Electric Boat	20	21	Western Union Tel.	88	88⅛
Electric Boat pfd	50	52	Westinghouse com.	163	159⅜
Electric Lead Reduction	9¼	9¼	Westinghouse pfd.	175	175

BOSTON.

	Mar. 22	Mar. 29		Mar. 15	Mar. 29
American Tel. & Tel	124	125¼	Western Tel. & Tel. pfd.	75	75
Cumberland Telephone	*115	114	Mexican Telephone	1¼	1¼
Edison Elec. Illum.	233	234	New England Telephone	117	120⅛
General Electric	168	168	Mass. Elec. Ry.	19	18½
Western Tel. & Tel.	8⅛	8¼	Mass. Elec. Ry. pfd.	72	72½

PHILADELPHIA.

	Mar. 22	Mar. 29		Mar. 15	Mar. 29
American Railways	43	43	Phila. Traction	95½	95⅛
Elec. Storage Battery	57	56	Phila. Electric	6	5¾
Elec. Storage Battery pfd.	57	56	Phila. Rapid Trans.	14	14
Elec. Co. of America.	8	8			

CHICAGO.

	Mar. 22	Mar. 29		Mar. 15	Mar. 2
Central Union Tel.	..	..	National Carbon pfd.	99¾	100
Chicago Edison	150	..	Metropolitan Elev. com.	16½	16
Chicago City Ry	155	165	Union Traction	5	5
Chicago Tel. Co.	..	..	Union Traction pfd.	3	30
National Carbon	28	29			

*Asked

ST. LOUIS BELL STOCK.—In order to provide additional capital for the removal in St. Louis of overhead wires, the connection of Southwest Missouri lines, extension of toll service, completion of its systems in the southwestern portion of the State, and the betterment of its urban properties, the shareholders of the Bell Telephone Company of Missouri will, on May 17, vote to increase the capital stock from $4,000,000 to $10,000,000. Treasurer Fritz Nisbet states that the directors will be given power to issue this stock from time to time. The right will be offered present holders of the stock to subscribe to the new issue at par.

NEW GENERAL ELECTRIC STOCK.—The $3,325,000 of new stock, the issue of which General Electric stockholders will be asked to approve at a special meeting on May 10, will leave approximately $4,387,600 stock available for sale to present holders. The authorized capitalization of General Electric is $45,000,000, of which $43,937,400 was outstanding in February, 1903, leaving $1,062,600 in the treasury. This balance, with the $3,325,000 now to be authorized, will make $4,387,600, or practically 10 per cent. of the outstanding capitalization, as it was reported a year ago.

ELECTRIC STORAGE BATTERY REPORT.—The Electric Storage Battery Company reports as follows for the year ended December 31, 1903:

	1903.	1902.	1901.	1900.
Gross	$1,761,058	.....	.....	$1,447,519
Expenses	352,048	.....	.....	297,779
Net	$1,409,010	.....	.....	$1,149,140
Other income	92,581	.....	.....	168,105
Total income	$1,501,591	$1,113,199	$900,243	$1,317,845
Dividends	812,435	812,427	812,413	.....
Surplus	$689,156	$300,772	$87,830	.....

The condensed balance sheet of the Electric Storage Battery Company as of December 31, 1903, is as follows:

Assets:	1903.	1902.
Plant investment	$283,482	$241,279
Treasury stock	1,750,575	1,750,575
Stocks and bonds in other corpor.	2,839,831	2,845,482
Patents, agreements and franchises	13,564,866	13,523,796
Mortgages	71,000	15,000
Cash	357,495	521,503
Accounts receivable	1,500,820	1,004,568
Notes receivable	240,528	47,065
Inv. accts., nat., stk., etc	707,829	574,329
Total	$21,316,429	$20,532,601
Liabilities:		
Preferred stock	$453,700	$5,000,000
Common stock	17,546,300	13,000,000
Accounts payable	107,011	94,292
Unpaid dividend scrip	1,737	1,737
Sundry liabilities	4,523	4,523
Profit and loss surplus	2,972,632	2,323,354
Res. for plant deprec., bad debts and unfinished contracts	230,522	104,216
Total	$21,316,429	$20,532,601

AMERICAN MARCONI REPORT.—The Marconi Wireless Telegraph Company, of America, issues the following statement as of January 31, 1904:

Assets:	1904.	1903.
Patent rights, good will, etc.	$5,318,494	$5,286,494
Cost of stations, etc.	175,606	139,939
Stock on hand	14,770	31,224
Accounts receivable	31,088	18,382
Cash	22,115	15,432
Furniture and fixtures	1,216	1,204
Treasury stock	582,760	700,000
Organization expenses, salaries, office and station expenses, etc.	85,183	35,468
Total	$6,231,232	$6,228,166
Liabilities:		
Capital stock	$6,190,000	$6,190,000
Accounts payable	17,232	38,166
Notes payable	24,000	....
Total	$6,231,232	$6,228,166

The annual meeting will be held on April 18.

DIVIDENDS.—The New England Telephone and Telegraph Company directors have declared the regular quarterly dividend of 1½ per cent., payable May 16. The directors of the Hall Signal Company have declared a regular quarterly dividend of 1½ per cent. on its common stock and a dividend of 6 per cent. on its preferred stock, payable April 1. The directors of the Cincinnati, Newport and Covington Light and Traction Company have declared the regular quarterly dividend on the preferred stock of 1⅛ per cent., payable April 15.

MICHIGAN TELEPHONE BONDS.—A deed conveying all the property of the Michigan Telephone Company to the Michigan State Telephone Company, as the assignee of N. W. Harris, the purchaser under foreclosure, has been filed. There was filed at the same time a first mortgage executed by the Michigan State Telephone Company to the Old Colony Trust Company, of Boston, for $10,000,000 to secure an issue of a like amount of 5 per cent. thirty-year gold bonds.

BOSTON AND WORCESTER TROLLEY.—The Boston and Worcester Street Railway Company has petitioned the Massachusetts Railroad Commissioners for permission to issue $100,000 additional capital stock and also $200,000 twenty-year 4½ per cent. bonds, the proceeds to be used to pay for expenses and new equipment.

KEYSTONE TELEPHONE BONDS.—It is stated that as soon as market conditions will permit, the Keystone Telephone Company, of Philadelphia, Pa., will ask authorization to issue $5,000,000 bonds, of which $3,500,000 will be sold at once.

BRITISH MARCONI WIRELESS.—The report of the Marconi Company for the year ended September 30 last, to be submitted to the annual meeting, shows receipts for the year of £36,376, £10,607 in excess of the general charges.

CUMBERLAND TELEPHONE reports February gross $319,591, as compared with $277,769 last year, with a net gain in surplus of $31,121, the total February surplus being $118,556.

Commercial Intelligence.

THE WEEK IN TRADE.—Retail business has improved somewhat under the stimulus of better weather, and the tone of wholesale and jobbing trade is thereby strengthened. On the whole, however, distribution is not equal to that of a year ago. Other favorable features are the better winter wheat condition, and evidences of further activity and strength in the iron and steel trades. There is more doing in building, but threatened disturbances in labor circles constitute a drawback at several large centers. Country roads are in poor condition and collections are a source of complaint. Railway earnings tend to improve as transportation difficulties are surmounted, and the outlook is that gross receipts for March will show a slight increase over those of the corresponding month last year. There is still complaint of lack of cars, particularly in the coke producing districts. The decisions of the bituminous coal miners not to strike has been a decided element of strength to general business throughout the West. The industrial situation is quite satisfactory, although unrest tends to increase as spring advances. Reports from the Northwest indicate that the lumber cut in that section is much smaller than that of a year ago. In Maine, however, the cut is a good one. It is reported that Minneapolis flour mills have shut down, owing to the decreased demand for flour. Export trade from San Francisco is good with all parts of the world except Hawaii. Recent rains in the lower Mississippi Valley have helped the farmers, who are now actively engaged in planting. Cotton is coming up in Texas, where the winter wheat crop is in good condition. The situation in the metal markets generally is a very satisfactory one. Finished products have improved. Sales of steel rails are more numerous, and transportation companies are buying shop and track materials, an order for 8,000 cars having been placed with Chicago manufacturers. The market at Pittsburg for steel billets and sheet bars is very firm, with a heavy demand. The country's iron furnaces are pretty well supplied with orders up to July 1, and finishing mills have fully three months' production booked. Other metals have been stronger, copper notably so on an increased foreign and domestic demand. Domestic consumers are showing rather more interest, but orders from home sources are still below the average. The lack is, however, off-set by the very large export business which amounts to 15,500 tons so far this month and is expected to reach 20,000 to 21,000 tons for the entire month of March. The closing prices of the week were 12¾ @ 13 c. for Lake; 12⅝ @ 12⅞ c. for electrolytic, and 12½ @ 12¾ c. for casting stock. During the week ending March 24 there were 215 business failures, according to *Bradstreet's* compilation, against 193 the week previous and 175 the corresponding week last year.

INCANDESCENT LAMPS.—It is understood that incandescent lamp makers have been holding convention in Cleveland and New York the last week or two, but the intention and results have not been disclosed. A great many rumors are afloat as to the object and "plan of campaign." One definite statement that is warranted, however, by the conditions known as we go to press is that the Sawyer-Man Company, which is controlled by the Westinghouse Electric interests, has declined to enter the pool, or combination, or whatever it may be, as to policy and prices. Pending authoritative announcements on the general subject, the following from a Cleveland newspaper will fairly serve the same purpose: "Electric lamp manufacturers all over the country have formed an agreement by which prices will be maintained at a uniform rate. The agreement was reached at a meeting of representative manufacturers last week at The Hollenden. There was no suggestion of combination and competition will be as active as before, but by uniting on uniform rates cutting will be eliminated and competition will be determined by quality of products, thereby greatly benefiting the consumer, it is said. The meeting was called to make adjustment of the differences existing between the various companies because of the universal use of patents controlled by the General Electric Company. This concern owned a number of patents for incandescent lamps, but the patents had been in general use by all the manufacturers. The General Electric Company was finally forced to press its claims in self-defense and suits were begun against manufacturers and dealers who had been using the patents. The latter concluded that they had better pay royalties and be sure of their ground, rather than bear the expense of litigation, and such arrangements were made with every lamp company in the country. These companies, in taking the license, agreed to maintain the scale of prices which had been observed by the best established companies for a number of years. This action will not raise the price above that formerly charged for first-class lamps, but will take off the market lamps of unrecognized makes for which, it was claimed, was charged any price the purchaser would pay. The result will be that the purchaser will pay no higher price than formerly and will be sure to incur no liability for damages for infringement of the patents, dealers claim. All suits against the licensees and customers are withdrawn and the arrangements do not affect the identities or the managements of the various companies concerned in the least. The prices are those under which the Edison lamp has been sold. All existing contracts will be filled at the prices prevailing at the time of contract."

SOME C. & C. ORDERS.—The C. & C. Electric Company, 143 Liberty Street, New York, has secured an order for a 300-kw, three-bearing belted generator from the Electric Company of America, Philadelphia. The machine will be used for both light and power purposes in the company's central station plant at Atlantic City, N. J. The Aetna (Ind.) Power Company has ordered one 180-kw and one 40-kw two-bearing generator for light and power use. A 100-kw, direct-connected generator has been called for by the Citizens' Electric Light & Power Company, of Altoona, Pa. The engine will be a 150-hp one, built by the Erie City Iron Works. This outfit is intended for lighting. A generator of 100-kw capacity has been ordered by the National Meter Company for direct connection to a Nash gas engine. This equipment is to be used for lighting the Steeplechase Park at Coney Island. A similar outfit has been ordered for shipment to St. Louis, Mo. Two 40-kw and one 25-kw direct-connected generators have been ordered for the Mechanics' laboratory, University of Pennsylvania, Philadelphia. The engines will be of Westinghouse manufacture. A 12½-kw, also an 18-kw generator, have been ordered by the National Meter Company for direct connection to 20-hp and 30-hp Nash gas engines for the St. Louis exhibition. The Roberts Chemical Company, of Niagara Falls, is to be shipped a 100-kw special generator for direct coupling to an alternating-current motor already installed. This equipment will be used for electrolytic purposes. A 125-kw engine type generator is to be installed in the plant of the Brylgon Steel Casting Company, at New Castle, Del. The engine will be of Harrisburg build. The C. & C. people also report receipt of an order for a number of motors to be used for driving machine tools in the Boston Navy Yard. Three motors have also been ordered through Feer & Clarkson, of Lebanon, Pa., for operating hoists at the Brooklyn Navy Yard.

LAUNCH WORK AT BAYONNE, N. J.—The Electric Launch Company is very busy with a great many orders for various types of pleasure launches and yachts. W. B. Dinsmore, Jr., of New York, has placed an order for a 21-foot electric launch for use on Tuxedo Lake. The success of the electrics at Tuxedo during the past two years has very much interested society, and boating is expected to become very popular during the coming season. Mr. A. Montgomery Ward, of Chicago, has ordered a 30-foot electric launch for use at Oconomowoc, Wis., one of Chicago's most attractive summer resorts. The launch will be of special design so that it can be taken from one lake to the other over an incline railway built by the cottagers, connecting two lakes. Mr. C. A. Grippin, of Bridgeport, has ordered a large electric cabin launch for use at Lake George. The launch will be used for pleasure purposes and also for conveying guests from the railroad station to Mr. Grippin's camp on Cull Bay Point, where for two years he has been building his summer home. A private electric light plant for lighting the residence and charging the launch has been installed. By an ingenious arrangement the residence can be lighted by the electricity in the launch if the electric plant is not running. Mr. Moritz Walther, of New York has purchased a large electric cabin launch for use on Upper Saranac Lake in the Adirondacks. This boat will join a large fleet of electric boats now in use on this lake. A powerful electric searchlight will be furnished the launch, enabling the boat to navigate at all hours of the night.

LORAIN SPECIAL WORK FOR MANILA.—The Lorain Steel Company branch of the United States Steel Corporation has captured the contract for the special work for the Manila electric traction system, in face of severe British competition. The contract, which is valued at about $30,000, calls for delivery of the material May—June. As previously noted in these columns, J. G. White & Co. have the contract for the construction of the system, which is also to light the Philippine capital. An American syndicate composed of Charles F. Swift, of Detroit, Mich.; Ex-President Frank H. Buhl, of the Sharon (Pa.) Steel Company; F. Kimberley, of Sharon; J. G. White, President Smith, of the Pittsburg Securities Company, and other Westinghouse interests, will operate the lines, etc. Westinghouse equipment will be installed in the power station. A contract will be awarded next week for 100 cars.

HUGE CONTRACT FOR ANDERSON SWITCHES.—The Albert & J. M. Anderson Manufacturing Company have secured what is said to be the largest contract for switches ever awarded. The contract was allotted by the New York Edison Co. and calls for special type edgewise switches in the manufacturing of which no less than 58 tons of copper will be used. Delivery is called for in six months. The Metropolitan Street Railway Company of New York has ordered a substantial lot of big service switches. Eccles & Smith, of San Francisco, have sent in a requisition for 3,000 straight line hangers, ears, pull-offs, etc., for use on the new 30-mile Huntington road. The Interborough Rapid Transit Company of New York has ordered 700 heater switches with magnetic blowout. An elaborate switchboard outfit has been ordered for the purpose of testing different kinds of current in the Lamp Testing Bureau, New York. The Anderson people have also got a number of fair-sized orders in hand for their various specialties to be shipped to the British electrical engineering and contracting concern, Robert W. Blackwell & Co., Limited.

THE BALL ENGINE COMPANY, Erie, Pa., has made the following recent shipments: National Tube Works, Pittsburg, Pa., one 800-hp cross compound Corliss engine, direct connected to alternator. United States Coal Company, Dillonvale, Ohio, one 500-hp Corliss direct-connected engine. Whiting Foundry Equipment Company, Harvey, Ill., one 400-hp Corliss direct-connected engine. Continental Coal Company, Jacksonville, Ohio, one 400-hp engine. Steamer "City of Buffalo," Detroit, Mich., one 80-hp direct-connected engine. J. M. Denholm Bros. & Co., Ltd., East Liberty, Pa., one 150-hp direct-connected engine. Leyden Coal Co., Leyden, Colo., one 175-hp engine. Forest Park Highlands Amusement Company, St. Louis, Mo., two 175-hp direct-connected engines. Semet-Solvay Co., Syracuse, N. Y., two 150-hp direct-connected engines. Dilworth, Porter & Co., Ltd., Pittsburg, Pa., three 50-hp engines. Union Ice Company, Bakersfield, Cal., one 350-hp engine. Soldiers and Sailors' Home, Grand Island, Neb., one 75-hp direct-connected engine.

TRANSMISSION IN OREGON.—The Rock Creek Power and Transmission Company of Baker City, Oregon, is installing a plant near that place, consisting of two 400-kw three-phase, 60 cycle General Electric generators, directly coupled to 900-hp water wheels, running at 450 r.p.m. The latter were furnished by the Pelton Water Wheel Company, of San Francisco, and operate under a head of 960 ft. Three 300-kw three-phase transformers raise the voltage to 22,500—at which pressure it is transmitted 27 miles to Baker City, and 17 miles in another direction to adjoining mining properties. A mixed light and motor load has been secured up to capacity of the two generators. The latter will operate during the greater portion of the time in parallel, but a single governor of the hydraulic pattern will control both units. This plant is the most important of its kind in eastern Oregon, and is expected to be in commercial operation the latter part of this coming May.

EQUIPMENT FOR MEXICAN CAR SHOPS.—Now that the Mexican Car & Foundry Company, S. A., has been organized under the concession granted to Isaac M. Hutchison, of Mexico City, contracts for machine tools, which are to be electrically operated, will be let practically immediately for installation in the company's plant to be built about four miles north of the Mexican capital. The initial capacity of the factory will be five cars daily. Later on it is intended to build trolley cars. M. Hutchison is president and general manager of the company. He has represented the Mexican interests of the St. Louis Car Company for some time past. He also looks after the business of the Niles-Bement-Pond Company and A. L. Ide & Sons. About $100,000 gold will be expended for equipment in the first instance. The works will be electrically lighted.

LIGHTING EQUIPMENTS FOR NEW YORK.—The engineering and contracting firm of Mackenzie, Quarrier & Ferguson, 114 Liberty Street, New York, has secured within the past few days several orders for Harrisburg engines to be installed in New York. The Women's Hospital, One Hundred and Tenth Street, is to be equipped with two 150-hp engines to be direct connected to 100-kw Western Electric Company generators, for lighting purposes. Luchow's Restaurant, Fourteenth Street, is to be provided with a 90-hp engine for direct connection to a Western Electric generator of 60-kw capacity, also for lighting use. The Hanover Fire Insurance Company, 34 Pine Street, has ordered a 75-hp engine to be direct connected to a 50-kw General Electric generator. This outfit will be utilized for additional lighting purposes.

AMERICAN BRIDGE COMPANY.—A number of changes are announced in connection with the American Bridge Company. The Eastern and Pittsburgh divisions of the company's business have been abolished, and the plants now embraced in them have been put in charge of Mr. R. J. Davis, as operating manager, with headquarters in the Frick Building, Pittsburg. President Alfred J. Major gives the schedule below for the removal of the general offices of this company from Philadelphia to Frick Building, Pittsburg: March 26, president, assistant to president and operating manager, March 31, auditing department; April 9, treasury department. Notable gains and economies are expected to attend this concentration of effort and management.

EQUIPMENT FOR FLORIDA PLANT.—The Manatee Light and Power Company of Bradentown, Fla., is about to extend considerably its plant, and has just awarded contracts for additional generators and engines. The new machinery to be installed will have a capacity of 700 kw. The generators have been ordered from the Bullock Electric Manufacturing Company. There will be three machines, a 300 kw alternating-current engine type, 60-cycle, 200 r.p.m. generator; one 300-kw 550-volt, 200 r.p.m engine type railway generator, and a 550-volt belted railway generator of 100 kw capacity. The 300-kw generators will be direct connected to engines to be built by the Harrisburg, Pa., Foundry and Machine Works.

EQUIPMENT FOR MEXICAN MINES.—The United Mining and Development Company of America, 66 Broadway, has just let contracts through E. Gybbon Spilsbury, of the E. G. Spilsbury Engineering Company, 45 Broadway, for considerable electrical equipment to be installed in its Mexican property. A water power plant is to be built for the purpose of operating the company's mines. The initial equipment will be about 400 hp. The generator will be of Westinghouse build. A Pelton water wheel will be used. A large lot of machine tools to be electrically operated, have been ordered through Mexican concerns, who represent American manufacturers in the Southern republic.

GILMORE GENERATORS FOR ENGLAND.—The Gilmore Electric Co., of Boston, and Postal Telegraph Building, New York, recently secured a contract for four generators of 80-kw capacity each for lighting an asylum in the vicinity of Liverpool. The generators will be direct connected to Scotch engines. An order for six machines of similar capacity has just been received for shipment to London, where the generators will be used for both light and power purposes.

THOMAS INSULATORS FOR MEXICO.—Thomas & Son, of East Liverpool, Ohio, have been awarded a contract for 40,000 insulators by the Mexican Light & Power Company, Limited, for use in the construction of the Mecaxa-Mexico City transmission system. Various other interesting contracts will be let shortly by the Mexican company, whose New York offices are at 29 Broadway, and of which F. S. Pearson is the consulting engineer.

LIGHTING FOR BLOOMINGDALE STORE.—The Bullock Electric Manufacturing Company, through its New York office, has secured a contract for lighting equipment to be installed in Bloomingdale Brothers Department Store, East Fifty-ninth Street. A 150-kw three-bearing slow-speed belted generator and a 200-r.p.m. engine of 100-kw capacity direct-connected to a Watertown engine have been ordered.

CHICAGO, ILL.—Articles of incorporation will be filed at Springfield, Ill., by the United States Telegraph and Telephone Company. The plan, it is said, is to absorb the National Telegraph News Company of Chicago, the Sempire Clock Company of St. Louis, and the Chicago and Milwaukee Telegraph Company, of Milwaukee.

EQUIPMENT FOR TWENTY-THIRD STREET FERRY HOUSES.—It is proposed to install a plant of about 400-kw capacity for the purpose of generating current to light the new Central, Erie and Lackawanna ferry houses, West Twenty-third Street. Kenneth M. Murchison, Jr., 5 West Thirty-first Street, is now drawing up the plans.

ELECTRIC PUMPS FOR PHILIPPINE DRY DOCK.—The International Steam Pump Company, 114 Liberty Street, New York, has secured the contract for the large electrically operated Blake pumps to be used on the steel dry dock now under construction at Sparrow's Point by the Maryland Steel Company for use in the Cavite Naval Station, Philippine Islands.

WAGNER MOTORS ADOPTED.—The Wagner Electric Manufacturing Company, St. Paul Building, will fill all future power motor requirements for the Public Service Corporation of New Jersey. Under 35-hp the machines will be of single phase type. Above that size the motors will be polyphase.

ROBB ENGINE FOR SCOTCH LIGHTING PLANT.—J. G. White & Co., Ltd., of London, has placed an order for a 300-hp Robb engine which is to be installed in the municipal lighting plant at Perth, Scotland.

ELECTRIC ROCK DRILLS FOR NEW ZEALAND.—The Denver (Col.) Engineering Works have secured a substantial contract for electrically operated rock drills for installation in New Zealand mines.

THE PERKINS MACHINE COMPANY, South Boston, Mass., has purchased the Slater Engine Works at Warren, Mass. The Perkins Company manufactures presses, punches, shears, etc.

DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

(Published first issue of each month.)

AMERICAN ELECTROCHEMICAL SOCIETY. Secretary, C. J. Reed, 929 Chestnut Street, Philadelphia, Pa. General meeting, Washington, D. C., April 7, 8 and 9, 1904.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Secretary, Dr. C. E. Skinner, New Haven, Conn. Next meeting, St. Louis, Sept. 13, 1904.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty Street, New York. Meetings, last Friday each month.

AMERICAN RAILWAY, MECHANICAL & ELECTRICAL ASSOCIATION. Secretary, Walter Mower, 12 Woodward Avenue, Detroit, Mich.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, G. W. Tillson, Brooklyn, N. Y. Next meeting, St. Louis, Oct. 4, 1904.

AMERICAN STREET RAILWAY ASSOCIATION. Secretary, T. C. Pennington, 2020 State Street, Chicago.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Secretary, W. S. Barstow, New York City and Portland, Ore.

CANADIAN ELECTRICAL ASSOCIATION. Secretary, C. H. Mortimer, Toronto, Ont. Next meeting, Hamilton, Ont., June, 1904.

COLORADO ELECTRIC LIGHT, POWER & RAILWAY ASSOCIATION. Secretary, George B. Tripp, Colorado Springs, Col. Annual meeting last Wednesday in October.

CONNECTICUT STATE STREET RAILWAY ASSOCIATION. Secretary, E. W. Poole, Bridgeport, Conn. Annual meeting in November.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, D. Fleming, Harrisburg, Pa.

UNITED ELECTRICAL CONTRACTORS' ASSOCIATION OF NEW YORK STATE. Secretary, F. Fish, Rochester, N. Y.

ELECTRICAL TRADES SOCIETY (Member National Electrical Trades Association). Secretary, A. P. Eckert, 39 Cortlandt Street, New York. Board of Directors meets second Friday of each month.

ILLINOIS STATE ELECTRIC ASSOCIATION. Secretary, H. E. Chubbuck, LaSalle, Ill.

INDIANA PUBLIC UTILITIES ASSOCIATION. Secretary, A. M. Barron, South Bend, Ind. Next meeting, Indianapolis, Ind., Oct. 18, 1904.

INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES OF AMERICA. Secretary, Frank G. Jones, 48 West Jackson Boulevard, Chicago. Next meeting, St. Louis, Sept., 1904.

INDEPENDENT TELEPHONE ASSOCIATION OF SOUTHERN INDIANA. Secretary, E. W. Pichardt, Huntingburg, Ind.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Secretary, Frank P. Foster, Corning, N. Y.

INTERSTATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. M. Coleman, Louisville, Ky.

IOWA ELECTRICAL ASSOCIATION. Secretary, W. S. Porter, Eldora, Ia. Next meeting, Des Moines, April 20 and 21, 1904.

IOWA TELEPHONE ASSOCIATION. Secretary, C. C. Deering, Des Moines, Ia.

KENTUCKY INDEPENDENT TELEPHONE ASSOCIATION. Secretary, James Maret, Mount Vernon, Ind.

MAINE STREET RAILWAY ASSOCIATION. Secretary, E. A. Newman, 471 Congress Street, Portland, Me.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby Street, Boston, Mass. Meets second Wednesday of each month, except July and August.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers, Madison, Ind. Next meeting, St. Louis, July, 1904.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 44 Whitesboro Street, Utica, N. Y. Next meeting, St. Louis, Mo., September 14, 15 and 16, 1904.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, Ernest H. Davis, Williamsport, Pa. Next meeting, Boston, Mass., May 24, 25 and 26, 1904.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, J. H. Neal, 101 Milk Street, Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 114 Liberty Street, New York.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, T. R. Mercein, 85 Michigan Street, Milwaukee, Wis. Next meeting, St. Louis, Sept., 1904.

OHIO STREET RAILWAY ASSOCIATION. Secretary, Chas. Currie, Akron, Ohio.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL AND STEAM ENGINEERS. Secretary, C. J. Miller, Canton, Ohio. Next meeting, Columbus, O., May 13, 1904.

PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Secretary, G. P. Low, 600 Rialto Building, San Francisco, Cal.

SOUTHWESTERN ELECTRICAL ASSOCIATION. Secretary, J. L. Ellis, Oklahoma City, Okla. Next meeting, Dallas, April 25, 26 and 27, 1904.

SOUTHWESTERN GAS, ELECTRIC & STREET RAILWAY ASSOCIATION. Secretary, Frank E. Scovill, Austin, Texas. Next meeting, Dallas, April 25, 26 and 27, 1904.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, W. B. Brockway, 40 Morris Street, Yonkers, N. Y.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, W. W. Cole, Elmira, N. Y. Next meeting, Utica, N. Y., Oct. 11 and 12, 1904.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vt. Next meeting, Montpelier, August, 1904.

WESTERN SOCIETY OF ENGINEERS, Electrical Section, Chicago, Ill.

General News.

THE TELEPHONE.

JACKSONVILLE, ARK.—The Jacksonville Telephone Company has been incorporated with a capital stock of $1000. The incorporators are S. W. Murtishaw, W. G. Graham, E. J. McBride, E. C. Stone and Mrs. Emma C. Martin.

ROGERS, ARK.—The Tri-State Independent Telephone Association has been organized, Mr. W. T. Stahl, of Siloam Springs, being president; S. H. Slaughter, of Lafayetteville, vice-president; K. J. Comfort, of Westville, secretary, and W. D. Wasson, of Gentry, treasurer. The association represents independent lines in southwest Missouri, northwest Arkansas and northeast Indian Territory, and its object is the betterment of local and long distance service. A farmers' line service will be encouraged. A meeting of the association will be held in June.

WASHINGTON, D. C.—The District Telephone Company has been incorporated with a capital stock of $1,000,000. The directors are C. S. Walton and J. H. Ralston.

LEWISTON, IDAHO.—A franchise has been granted to the Nez Perce Co-operative Telephone Company to operate and maintain a telephone line in this city.

WYOMING, ILL.—The Fidelity Telephone Company has been incorporated with a capital stock of $25,000. The directors are A. L. Johnston, A. B. Hoff and others.

TREMONT, ILL.—The Tremont Independent Telephone Company has been incorporated with a capital stock of $20,000. The directors are A. J. Davis and W. H. Ames.

WILLIAMSVILLE, ILL.—The Sangamon Telephone Company has been incorporated with a capital stock of $2500. The directors are J. P. Telfer, R. U. Richardson and others.

EAST LYNN, ILL.—The Fountain Creek Telephone Company has been incorporated with a capital stock of $34,000. The directors are W. A. Yeasel, G. H. Wiel and others.

HEBRON, ILL.—The Farmers' New Era Telephone Company has been incorporated with a capital stock of $5000. The directors are George Hunt, L. A. Nichols and others.

JOHNSON CITY, ILL.—The Good Service Telephone Company of Johnson City has been incorporated with a capital stock of $2500. The incorporators are J. E. Poindexter, D. H. Penson and Calvin Dillon.

TROY, ILL.—A license has been issued by the Secretary of State for the incorporation of the Troy Telephone Company, of Troy, Ill. The capital stock is $10,000. Incorporators: J. H. Steinhaus, J. W. Gornett and C. Busse, Jr.

CHICAGO, ILL.—The United States Telegraph and Telephone Company has filed articles of incorporation in this State. Among the incorporators are Col. G. Watson French, of Davenport, Iowa; Henry E. Weaver, H. L. Turner and H. D. Critchfield, of Chicago; Max R. Ortvine and A. B. Hulit, of St. Louis. This probably means the entrance of independent telephone toll lines to Chicago. H. D. Critchfield, one of the incorporators, is general manager of the Automatic Electric Company and closely identified with the Illinois Tunnel Company. It is rumored that the Chicago & Milwaukee Telegraph Company's line will be taken over by the new company.

HANCOCK, IND.—The Coffman-Heller Telephone Company has been incorporated with a capital stock of $120. The directors are G. W. Coffman and others.

FORT WAYNE, IND.—The annual meeting of the stockholders of the National Telephone & Telegraph Company was held here recently and officers were elected as follows: President, Henry C. Paul; vice-president, Charles S. Bash; secretary, William L. Moellering, and treasurer, William A. Bohn. The company operates exchanges in several towns in this part of the State. The financial statement showed that the earnings were satisfactory and exceeded those of last year by several thousand dollars.

RUSHVILLE, IND.—The Rushville Telephone Company held a meeting on March 18 to devise a plan to raise additional capital necessary to extending the lines and purchasing a new and modern switchboard. The company's plant has proven a paying investment, and the 200 stockholders voted that each shareholder increase the amount of his stock. By this plan $32,000 was raised and extensive improvements are now assured. L. C. Lambert, a local capitalist, offered to buy the plant and said he would agree to expend $100,000 on it for betterments during the next ten years.

TAMA, IA.—The Tama Telephone Company has been incorporated with $15,000 capital stock.

STUART, IA.—The Lincoln & Stuart Telephone Company proposes to establish a local exchange.

POCAHONTAS, IA.—The Pomeroy-Palmer Telephone Company has been formed to build a rural line.

PORTLAND, ME.—The Northeastern Telephone Company is preparing to extend its lines to South Windham and Raymond. This company operates an automatic system.

AMBOY, MICH.—The Clear Fork Telephone Company has been organized here.

MILLIKIN, MICH.—The Michigan Bell Telephone Company will build an exchange here.

RED WING, MINN.—D. M. Neill and others contemplate establishing a local telephone exchange.

ST. CLOUD, MINN.—The Clearwater Telephone Company has increased its capital from $10,000 to $25,000.

SLAYTON, MINN.—The Enterprise Telephone Company has been granted a franchise for a telephone exchange.

ST. PAUL, MINN.—The Armstrong Telephone Company will increase its capital stock from $25,000 to $100,000.

MAZEPPA, MINN.—A farmers' telephone line is to be built from Mazeppa covering Bear Valley and Zumbro Falls.

WILLMAR, MINN.—The Lake Andrew & Dover Telephone Company has been formed here by farmers. A 30-mile line will be built.

ST. PAUL, MINN.—The Armstrong Telephone Exchange Company of Truman has increased its capital stock from $25,000 to $100,000.

OVANDO, MONT.—Articles of incorporation of the Big Blackfoot Telephone Company, which will operate between this city and Drummond, have been filed with the Secretary of State.

HANNIBAL, MO.—The Missouri & Kansas Telephone Company is seeking a franchise here for an exchange.

ST. LOUIS, MO.—The Kinloch Telephone Company, of this city, announces that its lines to Carthage and Joplin will be completed by June 1. In the "zinc belt" the independent companies show great increase in earnings.

JEFFERSON CITY, MO.—The Laddonia, Rush Hill & Mexico Union Telephone Company has been granted a certificate of incorporation. The capital stock is $1000. The incorporators are: J. N. Rosser, E. A. Featz, C. L. Stewart, J. C. Maxwell and T. J. Roberts.

ST. JOSEPH, MO.—The Missouri River Telephone Company, with a capital stock of $150,000, has filed articles of incorporation. The company is composed of J. E. Zeluff and Walter S. Dickey, of Kansas City; W. T. Rankin, Frank S. Travis and John R. Stafford, of Tarkio, and Ralph O. Stauber, of St. Joseph.

LINCOLN, NEB.—The Hay Springs Alcova Telephone Company has been incorporated with a capital stock of $25,000.

NEWARK, N. J.—The Newark Telephone Exchange has been incorporated; capital, $25,000. Directors: E. A. Smith, J. E. Pulver, E. P. Thatcher, Newark.

WOLCOTT, N. Y.—The Farmers' Co-operative Telephone Company has been organized here by J. P. Fowler, Fred Brown, S. Sears and others.

ALBANY, N. Y.—The Sherburne Telephone Company has been incorporated with a capital stock of $10,000. The directors are: Jesse H. Shepard, F. G. Shepard, H. A. Shepard, Estella A. Shepard, Charles A. Fuller and Frank C. Cashman.

TROY, N. Y.—The Commercial Union Telephone Company has been organized here for the purpose of merging the Rensselaer Telephone Company of this city, the Saratoga Telephone & Telegraph Company of Saratoga Springs and the new Union Telephone Company of Glens Falls. The new company elected J. T. Christie, president; W. Levis Burke, secretary, and Peter McCarthy, treasurer. It will extend its lines.

BISMARCK, N. D.—The Milton Telephone Company has been incorporated with a capital stock of $10,000.

BOWBELLS, N. D.—A telephone exchange is proposed in this place, Mr. G. L. Bickford being one of those interested in the enterprise.

BORDEN, OHIO.—The Laurel Telephone Company of Borden has been incorporated with a capital stock of $1000 by William R. Jackson, Edwin Packwood, F. M. Vance and E. Ross.

ALLIANCE, OHIO.—The Stark County Telephone Company will establish an exchange at Louisville and will give toll connection with farmers in Harrisburg, Fairport, Pairs and other villages.

GETAWAY, OHIO.—The Getaway Telephone Company, of Getaway, Lawrence County, has been incorporated with a capital stock of $5000, by J. E. Schneider, John W. Gerlach, W. W. Poindexter, W. T. Cox and G. W. Thader.

CINCINNATI, OHIO.—The Council of Norwood has granted a 25-year franchise to the Norwood Citizens' Telephone Company, which is an independent concern. This is regarded as an entering wedge in favor of the admission of independent service in this city.

TOLEDO, OHIO.—What is said to be the largest single extension to a telephone switchboard in America has just been completed at the exchange of the Home Telephone Company in this city. The extension has a capacity of 1000 connections, which bring the total capacity of the exchange up to 7000 lines. The new work was done by the Sterling Electric Company, of Lafayette, Ind., and cost about $29,000, making the total expenditure on account of the switchboard $148,000.

TITUSVILLE, PA.—The Pennsylvania Railroad Company is installing a telephone line on its Chautauqua Division.

EMERY, S. D.—The Tri-County Mutual Telephone Company is seeking a local franchise.

MITCHELL, S. D.—The Dakota Central Telephone Company will build a line from Aberdeen to Mitchell.

GARRETSON, S. D.—A telephone company has been organized to build a local and rural system. A. J. Berdahl is interested.

FORT SUPPLY, TEX.—The Fort Supply Telephone Company has been incorporated with a capital stock of $10,000. The incorporators are: J. T. Brewer, J. P. Gandy, Robert Simis, M. W. Phillips and J. S. Peterson.

CHARLESTON, W. VA.—A charter has been granted here to the Wheeling & Pittsburg Telephone Company, of Wheeling, W. Va., which has been incorporated with a capital stock of $100,000. The incorporators are: J. A. Howard, J. P. Young and F. C. Handlan, of Wheeling; R. C. Hall and J. G. Plant, of Pittsburg.

DALLAS, WIS.—J. A. Anderson is seeking a franchise for a telephone exchange.

GRANTSBURG, WIS.—A telephone company has been formed at Swiss to build a line from Gordon to Grantsburg.

ELECTRIC LIGHT AND POWER.

GURDON, ARK.—The City Council has granted S. Scott Harris and T. L. Hodges a franchise for an electric light and power plant.

WASHINGTON, D. C.—It is reported that certain officials of the government are considering a plan to establish in the vicinity of the west end of the Mall an immense power house from which heat, light and electric power will be supplied to all government buildings in the northwest and southwest sections of the city. The plan at this time has not assumed definite form, but the proposition is being discussed among a number of government officials who seem to favor the project.

ALBANY, GA.—The city of Albany has contracted with the Albany Power & Manufacturing Company for 300 horse-power to be delivered at the city electric light plant at $8000 annually. The power company is developing a big power on Muckafoonee Creek near the city. The matter will be submitted to a vote. The saving to the city is estimated at $3000 or more per annum.

DUQUOIN, ILL.—The City Councils of Duquoin and Pinckneyville have in contemplation the construction of an electric light plant to give service to both places.

RIDGEFARM, ILL.—The matter of issuing $10,000 bonds for a municipal lighting plant is under consideration.

MOROCCO, IND.—H. D. Hallett, of Aurora, is preparing plans for water works and an electric light plant, to cost $26,000.

JEFFERSON, IND.—Local capitalists, headed by Hon. Louis Schneck and George H. Voight, have employed hydraulic engineers to examine Fourteen Mile Creek and the Tunnel Mill property with a view to utilizing the falls for developing power. A company will be formed to establish a power house for generating electricity by water power. The experts say that sufficient fall can be had to furnish 10,000 hp. It is the intention to operate an electric railway connecting this city and New Washington by this power.

CLARION, IA.—The City Council has decided to expend about $6000 in improving the electric light plant.

HOUGHTON, MICH.—The Portage Lake Gas & Coke Company has petitioned for a franchise to establish electric and gas lighting.

KALAMAZOO, MICH.—Application has been made by H. C. Hoagland for a receiver for the Kalamazoo Valley Electric Company. The Kalamazoo Company furnishes power to many factories in Kalamazoo and Battle Creek, and also supplies the power for the operation of the electric railways between Allegan and Jackson.

DULUTH, MINN.—Bids will be received April 11 by the Common Council for $50,000 bonds to be used for extending and improving water and light plant. H. W. Cheadle is City Clerk.

MINNEAPOLIS, MINN.—The effort of the Retail Dealers' Association to bring the Minneapolis General Electric Company and the city council to an agreement on a franchise has come to naught.

CARTHAGE, MO.—The Carthage Heat, Light & Power Company has been incorporated with a capital stock of $100,000, all paid. The incorporators are S. A. Stucky, I. C. Hudson and D. C. Brainard.

HARVARD, NEB.—J. J. Keefe, of York, Neb., has secured the franchise for an electric light plant.

OMAHA, NEB.—The Omaha Electric Light & Power Co. is planning to expend $75,000 in improvements on its plant this spring.

VALATIE, N. Y.—The City Clerk writes that it was voted March 15 to construct an electric light plant.

LOCKPORT, N. Y.—The Lockport Light, Heat & Power Company has been incorporated, with a capital of $75,000.

ALBANY, N. Y.—The Nassau Light & Power Company, which was recently incorporated, has increased its capital stock from $500,000 to $1,500,000.

FT. EDWARD, N. Y.—The Village Trustees have granted a franchise to the Hudson River Electric Company to furnish electricity for power, heat, fuel and lighting purposes.

ALBANY, N. Y.—The Heat, Light & Power Improvement Company of America, of New York, has been incorporated; capital, $600,000. Directors: James P. Lowery, Andrew Ritchie and Charles T. Eldridge, New York.

SYRACUSE, N. Y.—The Syracuse syndicate which owns the controlling stock of the Wayne County Electric Light & Power Company, is anxious to dispose of its interests in the same to business men of Lyons and Clyde.

AMSTERDAM, N. Y.—The Citizens' Electric Company, of Amsterdam, has been incorporated with a capital stock of $50,000. The directors are: William W. Dickson, Frank W. La Chapelle, Maurice G. Walsh, George C. Stuart and W. Fenton Myers, of Amsterdam.

NEW YORK, N. Y.—Bids will be received April 23 by Mordecai T. Endicott, chief of the Bureau of Yards and Docks, Navy Department, Washington, D. C., for installing a turbo-alternator with exciter set, 5 induction motors, 1 motor generator, 2 switchboards and accessories at the navy yard here. Estimated cost, $44,000.

CONCORD, N. C.—The town of Concord has voted to purchase the electric light plant at $8500.

SALISBURY, N. C.—The Salisbury and Spencer Railway & Electric Company has bought the Salisbury Gas & Electric Lighting Company.

WAYNESVILLE, N. C.—B. J. Sloan has contracted to furnish the city of Waynesville with power for light for 10 years, the power to be generated at a falls on Pigeon River, by the erection of a dam. The capacity of the plant will be 1500 horsepower. The city will take at least 125 horsepower at $20 per horsepower per annum.

HAMILTON, OHIO.—The city will issue $5000 in bonds for the purpose of improving its lighting system. Walton S. Powers is secretary.

MARYSVILLE, OHIO.—Mr. McKibben, of Van Wert, is preparing estimate of cost, etc., for an electric light plant. The contract for lighting expires this spring.

CAMERON, OHIO.—The Cameron Pottery Company has made a proposition to the town council to light the streets. The company has recently completed its plant and has more power than it requires.

BEDFORD, OHIO.—Philadelphia, Pa., capitalists represented by E. A. Mandeville and Edw. Roberts, are stated to have purchased the plant of the People's Electric Light Company. It is proposed to enlarge the plant, and install some new machinery.

ZANESVILLE, OHIO.—Hon. C. U. Shryock, of Zanesville, has obtained a franchise from the village of Philo for the construction of an electric lighting plant and water works system. A plant will be erected at Taylorsville Dam where excellent water power will be obtained. The villages of Duncan's Falls and Taylorsville will also be supplied.

MT. VERNON, OHIO.—The city council has passed an ordinance granting a franchise to H. C. Hubbell, C. C. Hubbell and John W. Hawk for an electric light, power and hot water heating system. The rate of current shall not exceed 15 cents per kilowatt and arc lights are to be furnished at $65 per year on moonlight schedule. The plant is to be built at once.

BEAVERDALE, PA.—A charter has been issued to the Beaverdale Electric Light Company, of Beaverdale; capital, $5000. Directors: W. L. Hicks and C. O. Templeton, of Tyrone; C. F. Fraser, of Altoona, and T. J. Gates, of Tyrone.

BUSHKILL, PA.—A charter has been granted to the Bushkill Water Power Company, with a capital of $5000. The company intends using the water to furnish electric power for commercial purposes, and also for a cement mill which the company will erect in the near future.

KNOXVILLE, TENN.—At a meeting of the City Council an ordinance was passed on first reading to put all wires underground. The Council also reported at this meeting favorably on the city owning a lighting plant.

HEMPSTEAD, TEX.—W. P. Lipscomb is reported interested in the construction of an electric light plant.

BARTLETT, TEX.—Plans are being considered for the construction of an electric light plant, to light Bartlett, Granger and Holland.

RICHFIELD, UTAH.—The Clark Power Company has in view a project for establishing a large power plant near here which will supply sufficient power for all the towns in the county. The plant also includes the construction of electric railways.

SALT LAKE CITY, UTAH.—Articles of incorporation of the Shoshone Falls Power & Lighting Company have been filed at Boise. The company is organized with a capital stock of $2,500,000, and bonds of a like amount will be issued. The main promoters are McDonald & McCoy, of Chicago, although Utah and Idaho capitalists are largely interested in the project. The plan is to establish three power plants on the Snake River, where from 80,000 to 100,000 horse-power will be generated, the first plant to be installed at Shoshone Falls. The Utah Light & Railway Company expects to receive, for distribution, about 8000 horse-power, which will relieve it of the criticism it is now undergoing as a result of its inferior lighting service.

RICHMOND, VA.—Governor Montague has signed the bill appropriating $25,000 for the construction of a heat, light and power plant on the Capitol Square.

RICHMOND, VA.—The State Legislature of Virginia has refused to take up the matter of the city of Newport News issuing $100,000 bonds to establish a municipal electric light plant.

TOLEDO, WASH.—The City Council has granted W. A. Gray a franchise for an electric light plant.

BERKELEY SPRINGS, W. VA.—The Cacapon Power Company, of Berkeley Springs, has been incorporated, with a capital of $100,000, to use water power of Cacapon River, in Morgan County, to generate electric power for industrial plants. The company proposes to light both Hancock, Md., and Berkeley Springs with electricity. Incorporators: Morrison Barclay and Thos. Barclay, of Greensburg, Pa., and F. R. Reed and J. H. Siler, of Berkeley Springs.

NEW LONDON, WIS.—The city has purchased the local electric light plant and will make improvements.

MONTICELLO, WIS.—E. W. Van Norman, Village Clerk, writes that it was voted March 11 to issue $8000 bonds for an electric light plant.

QUEBEC, QUE.—Another electric company for the city of Quebec is likely to be formed soon under the name of the Quebec Electric Company. The idea of the new company is to install a hydraulic electric plant at Seven Falls, on the River Ste. Anne, in the county of Montmorency. The company will seek incorporation at the next session of the legislature for power to construct an electric railway from these falls to the city of Quebec by way of St. Paul, St. Joachim, Ste. Anne de Beaupre, Chateau Diver, L'Ange Gardien, Montmorency Falls, Beauport and Limpilpu, and to sell in these places electricity, heat and power.

QUEBEC, QUE.—The amalgamation of the two Quebec electrical companies, the Jacques Cartier Electric Light & Power Company and the Quebec Railway, Light & Power Company, which entered into a secret agreement some months ago, has been publicly announced. The latter company has just issued a circular to its clients, informing them of an increase in the rate of charges for the electric light service. Heretofore, ten cents per kilowatt, with a cash discount of 10 per cent., was charged consumers, and now they are called on to pay 15 cents per kilowatt with a 20 per cent. cash discount, which means a practical increase in the rates of 40 per cent. The result of this increase is that many of the consumers are returning to the use of gas and coal oil.

THE ELECTRIC RAILWAY

BESSEMER, ALA.—Local interests have raised funds for making a survey for an electric railway to extend from Bessemer to Blue Creek, Brookwood and Blockton. The move is at present purely a local one, with the end in view of including outsiders to lend aid if a favorable report is made on the project. S. E. Jones and W. J. Parkes are members of the committee which has the matter in charge.

SAN JOSE, CAL.—Articles incorporating the Santa Clara Valley Transit Company have been filed. The capital stock is placed at $1,000,000, of which $25,000 has been subscribed. The directors are: F. M. Lockwood, J. A. Mehling, V. A. Scheller, W. C. Andrews and A. D. Cutler.

PUEBLO, COL.—Leading citizens of Bessemer are the promoters of a plan to establish an electric railway here.

STONINGTON, CONN.—The Westerly Railway & Lighting Company, of Stonington, has filed a certificate of organization. The authorized capital stock is $400,000. The company will begin business with $20,000 capital. It is organized to construct and operate railroads, street railways, electric light plants, power plants, gas works and ferries. The directors are: James O. Sweet, Jewett City, Conn.; Francello G. Jilson and Frank P. Sheldon, of Providence; Nathan B. Lewis, of West Kingston, R. I.; Joseph M. Kingelsmith, of Stonington, and H. Hobart Babcock, George W. Mansfield and William Hoxsey, of Westerly. Subsequently, the directors elected Frank P. Sheldon president; George W. Mansfield, vice-president; Nathan B. Lewis, secretary, and Joseph M. Kingelsmith, treasurer.

WATERBURY, CONN.—The local municipal authorities have granted to the Cheshire Street Railway Company the necessary rights to construct the Waterbury end of the proposed line between this city and Cheshire. The Cheshire Company is an underlying corporation of the Connecticut Railway & Lighting Company.

HILLSBORO, ILL.—The Hillsboro Electric Railroad Company has been organized, with a capital stock of $15,000. The incorporators are: Isaac Hill, T. M. Jett and L. V. Hill.

EAST CHICAGO, IND.—The Hammond, Whiting & East Chicago Electric Railway Company has increased its capital stock from $300,000 to $1,000,000.

ANDERSON, IND.—The Indiana Union Traction Company will begin the construction of its new shops here this summer. The company has set aside $150,000 for this work.

CRAWFORDSVILLE, IND.—It is anounced that the Consolidated Traction Company will, in a few days, receive bids for the construction of a large power house in this city. Edward Hawkins is president of the company.

RICHMOND, IND.—The Richmond & Northwestern Electric Railway Company has been incorporated. The capital is $50,000, and the directors are: George M. Hodges, G. G. Bambach, W. D. Riddel and L. I. Lowman, of Dayton.

EVANSVILLE, IND.—The Evansville, Boonville & Rockport Traction Company has completed its survey to Rockport, a distance of 37 miles, and has contracted for private right of way from Evansville to Boonville, a distance of 17 miles.

INDIANAPOLIS, IND.—The Jackson & Fort Wayne Interurban Railway Company has filed articles of incorporation with the Secretary of State. The object of the corporation is to construct and operate an electric railway from Indianapolis to Jackson, Mich. The line will be 130 miles long. The capital stock of the company in Indiana is $50,000. The incorporators and stockholders are: John H. Roberts, Joseph McKee, Charles W. Wadkins, of Grand Rapids; Will H. Mann, of Muskegon; William Sullivan, of Mackinac Island, Mich.; Stephen H. Powers, of Angolia, Ind.

MARSHALLTOWN, IA.—It is reported that a contract has been closed with J. G. White & Company, of New York, for the construction of the Marshalltown Electric Street & Interurban Railway. The road will be built from Marshalltown to Grundy Center, 30 miles, and then, if feasible, will be extended to Parkersburg and ultimately to Charles City, on the north, and to Ferguson, south of Marshalltown. The power house will be built at Marshalltown.

LOUISVILLE, KY.—The Louisville & Southern Indiana Traction Company has been granted a franchise to enter the city.

PADUCAH, KY.—Articles of incorporation for the Kentucky & Ohio River Interurban Railroad Company have been filed here. The company is capitalized at $250,000, and the incorporators are: J. J. Freundlich, C. E. Whitesides, O. B. Williams, of Paducah; O. B. Pettit, of Wabash, Ind.; L. B. Whitesides, of Franklin, Ind., and C. T. Crump, of Columbus, Ind.

LAKE CHARLES, LA.—W. C. Easterling and W. C. Pfeiffer have applied to the City Council of this town for a franchise for constructing and operating an electric street railway system here. They represent a syndicate of Pennsylvania capitalists.

ANNAPOLIS, MD.—A bill will be introduced in the Legislature to grant a charter to the Baltimore, Westminster & Union Mills Railway Company. The incorporators of the company named are Charles E. Fink, Joseph Friedenwald, W. A. Jackson and others. The capital stock is to be $20,000.

ANNAPOLIS, MD.—A bill has been introduced in the Senate to incorporate the Roland Park Electric & Water Company. The capital stock is $25,000, and the company is to operate in Baltimore city. The incorporators are Edward H. Bouton, George Miller, Robert J. W. Hamill, Richard W. Marchant, Jr., and Osborn I. Yellott.

BOSTON, MASS.—The Nahant Selectmen have granted the franchise for the new electric railway between that town and Lynn to the Nahant Street Railway Company, which includes among its incorporators Senator Henry Cabot Lodge, George Abbot James and others. Frand Ridlon & Company will finance the road and supervise its construction.

WORCESTER, MASS.—Representatives of the Worcester & Northern Street Railway Company have been at work, so it announced in Worcester, buying up

stock of the Gardner, Westminster & Fitchburg Street Railway, which operates a line to the base of Mt. Wachusett. The Worcester & Northern proposes to run a line to the top of the mountain, using a cable road, and wants the line from Gardner and Fitchburg as a feeder.

ATTLEBORO, MASS.—Preliminary plans for a new street railway to connect the Milford, Attleboro & Woonsocket Street Railway with the Boston & Worcester road are well under way, and the legal papers have been drawn up and submitted to Boston capitalists, who will finance the new company. The company proposes to purchase the Caryville branch line from the Milford, Attleboro & Woonsocket Company.

WORCESTER, MASS.—It is announced that a company to be known as the Worcester, Southbridge & Sturbridge Street Railway Company is about to be formed, to acquire the Worcester & Southbridge Street Railway after that road has passed out of the hands of the receivers, and to acquire also the Southbridge & Sturbridge Street Railway, which has been operated under the Worcester & Southbridge management. The company is said to have a capital stock of $700,000. It is said that William E. Rice, who has been prominent in the settlement of the troubles of the Worcester & Southbridge Company, will be president of the new corporation. The two roads will be put up for sale at auction as soon as the claims have been adjusted, and it is the purpose of the new company to bid them in.

MONROE, MICH.—The Detroit, Monroe & Toledo Short Line is making extensive improvements at its power house in order to provide better facilities for handling the new extension to Detroit, which is now nearing completion. A new engine, generator and additional boilers are being installed.

GRAND RAPIDS, MICH.—The Grand Rapids, Holland & Lake Michigan Interurban Railway Company has elected members of the board of directors for the ensuing year. Directors organized as follows: Benjamin S. Hanchett, president; John P. Crozier, vice-president; Willard Kingsley, secretary; Strathearn Hendrie, treasurer and general manager.

MINNEAPOLIS, MINN.—The Twin City Rapid Transit Company proposes to extend its present White Bear line from Mahtomedi to White Bear village, passing through Dellwood and White Bear Beach.

LEXINGTON, MO.—The citizens of Lexington are considering the proposition of building an electric railway from Niggins ville to Lexington Junction. Gustave Maerie is the promoter.

KANSAS CITY, MO.—A sub-station is to be built at Twelfth Street and Cleveland Avenue by the Metropolitan Street Railway Company. Two rotaries will be installed, and from them power will be supplied to the car lines on the East Side. When the new station is in commission the stations at Eighth Street and Woodland Avenue and Eighteenth and Olive Streets will be shut down. The sub-station at Fifteenth and Walnut Streets will also be equipped with two rotaries. One will be transferred from the Kaw River power plant, the other is now on the way from the east. The equipment at the power station at Thirty-first and Holmes Streets will also be improved. Two engines at the new plant at Second Street and Grand Avenue are now in commission, and a third engine will be ready for service by June 1.

NEWARK, N. J.—President Thomas N. McCarter, of the Public Service Corporation, has made formal application to the Board of Public Works of Newark for permission to construct five extensions to the trolley system.

SUMMIT, N. J.—An agreement has been reached between the Springfield Township Committee and the Morris County Traction Company, whereby the company will be given a franchise through the township for its proposed electric railway from Summit to Elizabeth.

BATH, N. Y.—The Bath Town Board has granted a franchise to John Tuerk to construct the proposed electric railway from Branchport to Hornellsville.

LOCKPORT, N. Y.—It is announced that all the finances have been arranged for the completion this summer of the electric railway between Lockport and Rochester, via Albion.

ROCHESTER, N. Y.—The entire proceeds of the $100,000 of new stock recently authorized to be issued by the stockholders of the Rochester Railway Company will be used for improvements.

EAST AURORA, N. Y.—The Buffalo & Southeastern Electric Company has been granted a franchise to operate an electric railway here. John H. Boyle, of Utica, is promoting the company. The plan is to connect with Buffalo.

GREENSBORO, N. C.—The Greensboro Electric Company has decided to make many improvements to its system. It is said that a new steam turbine wheel will be installed at the power house. The boiler capacity of the plant will be increased and improvements will be made in the rolling stock.

TOLEDO, OHIO.—Stockholders of the Toledo & Indiana Railway Company will meet April 5 to discuss plans for extending the road westward and for the erection of a large power house.

CLEVELAND, OHIO.—The Eastern Ohio Traction Company will build a new line from Euclid Heights to Warrensville, which will provide a new route into the city for the cars of the Garrettsville division of the road.

COLUMBUS, OHIO.—The Marion, Bucyrus & Tiffin Railway & Light Company has been incorporated, with $10,000 capital stock, by M. B. Earnhart, J. B. DeWitt, S. S. Thorn, O. M. Blake and W. H. Davidson. The company proposes to build an interurban line between Marion, Bucyrus and Tiffin. This is one of the most important projected lines in Ohio, as its completion will make possible, through electric travel between Cincinnati and Toledo and Cincinnati and Cleveland. The Municipal Bonding & Securities Company, of New York, is financing the road.

GUTHRIE, O. T.—A territorial charter has been granted to the Oklahoma City, Lexington & Sulphur Springs Electric Railway Company, with headquarters at Lexington, with $1,000,000 capital. The incorporators are: Charles Stewart, of Parkersburg, W. Va.; H. A. Hawk, J. S. Little, H. L. Forehead and others.

FRANKLIN, PA.—Application has been made to the State Department at Harrisburg for a charter for a company to construct an electric railway from Franklin to Butler, a distance of 53 miles. The company is to be capitalized at $400,000.

ALLIANCE, PA.—An ordinance has been introduced in Council granting a franchise to the Blue Ridge Electric Passenger Railway Company. The line will run from Walnutport, along the Lehigh River, to Alliance, crossing over to Bath and Nazareth.

WILKINSBURG, PA.—A charter has been issued by the State Department to the Wilkinsburg & Braddock Electric Street Railway Company to construct a line from Turtle Creek to Wilkinsburg. The capital is $21,000. Hawley McKinney, of Pittsburg, is president.

PROVIDENCE, R. I.—The act authorizing the Pascoag & Providence Street Railroad Company to increase its capital stock to $300,000 has been passed by the Senate in concurrence with the House of Representatives.

CHATTANOOGA, TENN.—The stockholders of the Chattanooga Electric Railway Company have decided to build a line to Chickamauga Park.

OGDEN, UTAH.—The City Council has granted a franchise to the Ogden Rapid Transit Company to extend its system into the suburbs of the city. The equipment required will be ordered at an early date.

ST. ALBANS, VT.—The St. Albans Street Railway has suspended operations, and rumor has it that the company is financially embarrassed.

RICHMOND, VA.—It is stated that the Richmond Passenger & Power Company has under consideration the extension of its lines to Washington by way of Ashland and Fredericksburg.

COLFAX, WASH.—The Board of County Commissioners has granted a franchise to the Palouse & Spokane Electric Railway Company for an electric railway from Spokane to Colfax.

HAMILTON, ONT.—The Hamilton, Grimsby & Beamsville Electric Railway Company will make additions and improvements to its plant.

WOODSTOCK, ONT.—Wallace & Little, of this city, will apply for a charter for an electric railway between Crantford and Hamilton. David Brennan, of Detroit, and other American capitalists are interested.

NEW INDUSTRIAL COMPANIES.

THE EASTERN ELECTRIC COMPANY, of Newport News, Va., has been chartered, with A. L. Powell president.

THE MICHIGAN AUXILIARY FIRE ALARM COMPANY has been incorporated at East Orange, N. J.; capital, $30,000. Incorporators: Paul Muntur, Joseph Genwardt and Charles A. Green.

THE GUSTAVE S. NEU COMPANY of New York has been incorporated to deal in electrical supplies. The capital stock is $10,000, and the directors are G. S. Neu, Marion Neu and W. L. Frank, New York.

THE SHEDD ELECTRIC COMPANY, of Elizabeth, N. J., has been incorporated; capital, $250,000. Incorporators: William H. Peck, J. Foster Symes, C. A. Matthews, H. C. Henshaw and H. Richmond Palmer.

THE FIELD MULTIPLEX TELEGRAPH INSULATION COMPANY has been incorporated at Jersey City, N. J., with a capital stock of $20,000. The incorporators are James D. Campbell, R. W. Ashcroft and Kenneth K. McLaren.

THE INTERNATIONAL ACCUMULATOR COMPANY has been incorporated at Portland, Me., with a capital stock of $1,000,000, of which $50 has been put in. The officers are: President, Ardon W. Coombs, Portland; treasurer, Winfield S. Carpenter, Boston.

LEGAL.

NEW ORLEANS FRANCHISES.—At New Orleans, on March 26, Attorney-General Guion brought suit in the District Court to have the New Orleans Railways Company, a company chartered under the laws of New Jersey, declared unconstitutionally incorporated, and therefore unable to do business in Louisiana. The company has a capital of $80,000,000, most of the bonds being held in New York. It controls all the street car and suburban lines of New Orleans, besides owning the gas works and electric light plant of the city and furnishing all light—gas and electricity—for public and private lighting.

OBITUARY.

MR. H. H. CARPENTER.—Mr. Hiram H. Carpenter, an inventor of electrical devices, died on March 28 at Bellevue Hospital, New York City. He had recently returned from a European tour. He was born in Williamstown, Mass., sixty-four years ago, and was a cousin of the late United States Senator Matthew Carpenter of Wisconsin. He invented and improved some storage batteries, and lately had been engaged upon a wireless telephone. He was an officer in the Iron Brigade of Wisconsin in the Civil War, and commanded the Twentieth New York Cavalry during the latter part of the war.

MR. C. D. CRANDALL.—It is with deep regret that we note that Mr. Chester D. Crandall, manager of the Western Electric Company, died at his home in Edgewater, Chicago, March 22, 1904. He had been a prominent figure in the Bell telephone field for many years. Soon after he graduated from the University of Rochester in 1879, he became connected with the Western Electric Company. At one time he was associated with the Missouri & Kansas Telephone Company at Kansas City, but returned to the Western Electric Company. He was a member of the Union League Club and other prominent clubs in Chicago. He had been an associate member of the American Institute of Electrical Engineers for several years. He leaves a wife and daughter.

PERSONAL.

ASA M. MATTICE.

MR. ASA M. MATTICE has accepted the appointment of chief engineer of the Allis-Chalmers Company. Mr. Mattice was graduated from United States Naval Academy, Annapolis, Md., at the head of the class of Cadet Engineers of 1874, and remained in the naval service until 1889. During his 17 years' service, he was attached to the Naval Academy for three years as instructor in engineering, and acted three years as assistant to the Engineer-in-Chief of the Navy at Washington, D. C. The remainder of his duty was on board ship and at navy yards. While serving as assistant to the Engineer-in-Chief, he had direct charge of the designs for the machinery of the first vessels of the new navy, and the great success of the several new types originated led to their rapid adoption in the navies of the world. From the time of Mr. Mattice's resignation from the Navy until the end of 1899, he was the principal assistant to Mr. E. D. Leavitt, consulting engineer, Cambridgeport, Mass., where his work was principally in connection with large mining machinery, pumping engines, mill plants and power plants, along with a great deal of miscellaneous engineering. In 1900 he resigned to engage in independent engineering, but in December of that year accepted an appointment as chief engineer of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. In June, 1903, he was appointed chief engineer of the Westinghouse Machine Company, East Pittsburgh, Pa., and consulting engineer of the Westinghouse Electric & Manufacturing Company, which positions he held up to the present date. Mr. Mattice took up his new duties on April 1 with headquarters at the central works of the Allis-Chalmers Company, Milwaukee.

F. H. BETHELL.

MR. FRANK HOPKINS BETHELL has been appointed general manager of the Chesapeake & Potomac Telephone Company, with headquarters at Washington, D. C. He is one of the youngest managers in the present Bell telephone system to hold so prominent and responsible a position. Mr. Bethell began his telephonic career in that excellent school, the New York & New Jersey Telephone Company, and was connected with its Brooklyn office. He went thence to the New York Telephone Company, and for the past three years has been its contract agent. His work in this arduous position has been of a really brilliant character and has attracted considerable notice. During the three years of his incumbency the company has doubled the number of telephones in use in Manhattan and the Bronx, so that at the time this is written there are not less than 140,000 telephone stations installed or under contract in the district named, this being by far the largest telephonic network in the world. Mr. Bethell's success in New York has been due to his own efforts. He has a clever diplomatic way of handling men, and the high *esprit de corps* in the contract department is due to his methods, while at the same time he has made friends with the great New York public, so that complaints are rarely heard. Mr. Bethell has developed business in many ways, and is a great believer in advertising. His work in the New York newspapers, as well as in the booklets he has constantly sent out, has been attended with the splendid results as noted above. Great regret is felt by the officers of the New York Telephone Company as well as by Mr. Bethell's own immediate staff at his departure, but they realize that the move is strictly in the line of promotion and wish him abundant success. He begins his new labors on April 1. The principal points covered by the Chesapeake & Potomac Company are Washington, Baltimore, Annapolis, Belair, Cumberland, Frederick, Hagerstown, Westminster, Md., and Martinsburg, W. Va. Comprising as it does the national capital, this field involves at once great opportunities and great responsibilities, while at the present time the work is complicated by the heavy restorations necessary in Baltimore after the great fire.

MR. H. W. POTTER, of the export department of the Westinghouse interests, sailed March 29 for Panama. He expects to be absent about a month.

MR. B. E. SALISBURY, secretary and general manager of Pass & Seymour, Inc., of Solvay, N. Y., was in New York City last week on important business for that concern.

MR. CLINTON L. ROSSITER, president of Rossiter, MacGovern & Co., has gone to Mexico in connection with the Toluca Light & Power Company, in which he is interested.

MAJOR W. A. GLASSFORD, U. S. Signal Corps, upon his return to this country from service abroad shortly, will proceed to Atlanta, Ga., and report for duty there as signal officer.

MR. FRANCK Z. MAGUIRE, of London, has just arrived in this country by the "St. Louis," and will be here for two or three weeks, going first to Washington.

MR. S. B. FORTENBAUGH, electrical engineer of the Underground Electric Railways Company of London (Yerkes syndicate), is now in this country on a flying trip, and has been visiting Schenectady, etc.

MR. JOHN McDOUGALL, of Montreal, Can., who represents the interests of the International Steam Pump Company, 114 Liberty Street, in that part of the world, is now on a visit to New York.

MR. A. M. BARRON has moved from Indianapolis, Ind., to South Bend, Ind., where he will continue his engineering work. Mr. Barron is secretary of the Indiana Public Utilities Association, which will hold its next meeting at Indianapolis in October.

PRESIDENT CHARLES SUMNER HOWE is to be installed as head of the Case School of Applied Science, Cleveland, Ohio, on May 11. Considerable preparations are now being made for the inauguration exercises, and official invitations are being sent out.

MR. G. W. FRANK, of J. G. White & Co., 49 Exchange Place, New York, has gone to Mexico for the purpose of supervising the remodeling of the Monterey Electric Light & Power Company's plant, the contract for which is being carried out by J. G. White & Co.

MR. W. K. PALMER, consulting engineer, 402 Lyceum Building, Kansas City, Mo., is engineer for the municipal lighting plant for Versailles, Mo. Plans and specifications will be ready in about two weeks. Bids will be required on boilers, engines, generators, switchboard, poles, etc., together with the building.

MR. MARTIN MOLONEY.—A cable dispatch from Rome of March 26 says: "Marquis Martin Maloney, of Philadelphia, and Miss Maloney were to-day received in private audience by the Pope, who conversed with them at considerable length in the most cordial manner. They were presented to His Holiness by Cardinal Satolli."

MR. LOUIS F. MAHLER, formerly western manager of the De Laval Steam Turbine Company, and St. Louis manager for the Bullock Electric Manufacturing Company, is now representing the Buckeye Engine Company, of Salem, O.; the International Steam Engineering Company, of Atlanta, Ga., and New York, and the Chase-Shawmut Company, of Newburyport, Mass., at Suite 1008-9 Chemical Building, St. Louis.

DR. A. C. CREHORE, of Yonkers, N. Y., has issued in neat pamphlet form a recent article of his in *Country Life in America*, describing a new sun-dial that tells standard time all the time the sun shines and indicates the time of sunrise and sunset throughout the year. The gnomon of an ordinary dial is represented in this form by a phosphor bronze wire carrying a small metal bead.

MR. F. W. BENNETT, chief engineer of the Cienfuegos, Palmira & Cruces Electric Power & Railway Company, is expected to arrive from Cuba very shortly. The company is to build a large hydraulic plant for the purpose of generating power for light and traction use in the Santa Clara province. The consulting expert of the company is Mr. Cornelius C. Vermeule, 203 Broadway, New York.

MR. EDWARD BENNETT has resigned from the Nernst Lamp Company and with Mr. Murray C. Beebe will engage in engineering and expert work with offices in the Farmers' Bank Building, Pittsburg. Mr. Bennett became associated with the development of the Nernst lamp shortly after the inception of the work in this country, and for the past fifteen months has served as chief electrician of the Nernst Lamp Company.

MR. HUGH L. COOPER, at one time hydraulic engineer of the Stilwell-Bierce & Smith-Vaile Company, and who later on acted as expert in charge of the large water power plant on the Rio Tiete, Brazil, operated by the Sao Paulo Tramway, Light & Power Company, is now in charge of the construction of the Mexican Light & Power Company's extensive system. He has sailed for Mexico after a short visit to the States.

MR. EDWARD GUINLE, of the electrical engineering and contracting firm of Aschoff & Guinle, of Rio Janeiro, Brazil, will arrive very shortly on a somewhat extended visit to the United States. The firm represent the Brazilian interests of several large American electrical and mechanical concerns. Mr. Guinle will make his headquarters in the offices of G. Amsinck & Co., 6-9 Hanover Street. He is expected to place some large contracts.

MR. S. M. CONANT, now representing the Crocker-Wheeler Company of Ampere, N. J., in Atlanta, Ga., is to be married at Holy Trinity Church, Church Road, Richmond, Va., Tuesday, April 5, to Miss Helen Temple Southall, daughter of John H. Southall, treasurer of the Virginia Trust Company of Richmond. The ceremony will be performed by the Rev. C. M. Conant, M. D., father of the bridegroom, assisted by the Rev. Dr. Gravatt, rector of Holy Trinity.

MR. F. S. PEARSON, 29 Broadway, New York, has gone on a trip to Mexico for the purpose of inspecting the progress made in the construction of the Mexican Light & Power Company's Mecaxa plant, which is to generate initially no less than 45,000 hp for transmission to Mexico City, etc. Mr. Pearson is vice-president and consulting engineer of the company, which is controlled by Canadian capitalists. He expects to be back in about ten days.

MR. JAMES MITCHELL, general manager at Sao Paulo, Brazil, of the Sao Paulo Tramway, Light & Power Company, is expected to arrive in New York next week. Mr. Mitchell was formerly one of the partners of the recently dissolved firm of James Mitchell & Co., of Rio de Janeiro and Sao Paulo, which represented the interests of some of the leading United States electrical concerns. While in New York he will make his headquarters in the Sao Paulo Company's office, 29 Broadway.

MR. MURRAY C. BEEBE has resigned from the Nernst Lamp Company, and in association with Mr. Edward Bennett, has opened an office in the Farmers' Bank Building, Pittsburg, to engage in the practice of electrical and mechanical engineering and in expert work. Mr. Beebe was for several years an instructor in electrical engineering in the University of Wisconsin, which position he left to take up work on the development of the Nernst lamp, and when the Nernst Lamp Company was later formed, became its chemist and technical superintendent.

MR. GEORGE J. GOULD on his recent trip through the Southwest was so pleased, it is said, with the performance of the engine which drew his train over 5000 miles without a break that he presented the engineer and fireman who handled it with purses each containing $100 in gold. The locomotive plowed its way through snow, ran through the heart of the Salt River Valley, was fed with forty different kinds of coal, and used water of every known analysis in its boiler, yet the only repairs it needed were such as were made en route by the crew. His Manhattan Elevated electric locomotives have also been doing about as well.

MR. W. MARCONI has had the misfortune to lose his father, Mr. Giuseppe Marconi, at the age of 82, at Bologna, Italy. Mr. Giuseppe Marconi was born in 1823. The mother of William Marconi, of wireless telegraph fame, was his second wife. She was Miss Anna Jameson, daughter of the founder of the well-known Dublin firm. She was a beautiful girl and was sent to Italy to complete her education. She met in that country the elder Marconi, a dashing young Italian, who was of good family, in possession of a large estate near Bologna, their mutual liking arising out of a common taste for outdoor sports. Their elder son, Alfonso, was born in 1865 and William in 1874, at the family house, the Villa Grifone, near Pontecchio. Signor Marconi took great pride in his son's achievements.

MR. FRANK W. FRUEAUFF, auditor of the Denver Gas & Electric Company, has been asked by President Edgar to report on office methods and accounting at the 27th convention of the National Electric Light Association, to be held in Boston May 24-27. Mr. Frueauff is a very progressive young man, and as he is familiar with the up-to-date methods of keeping central-station accounts, including modern devices for saving time and insuring accuracy in office work, the report, which he has promised to prepare, is sure to be a valuable addition to the programme of the meeting.

PROF. F. G. BAUM, formerly assistant professor in the department of electrical engineering at Stanford University, California, has been appointed electrical engineer and general superintendent of the California Gas & Electric Corporation, which recently absorbed the Standard Electric Company and now controls all the local distributing companies around the bay. Prof. Baum will have entire charge of all construction and operation of the water systems, power houses, transmission lines and sub-stations of the company. Prof. Baum graduated from Stanford in 1898, taking the degree of electrical engineer a year later. He then became connected with the department as instructor and assistant professor. He resigned a year ago on his appointment as assistant electrical engineer of the corporation of which he becomes chief engineer and general superintendent.

MR. ANDREW CARNEGIE.—The reason for Mr. Andrew Carnegie's gift of $50,000 to Kenyon College, at Gambier, Ohio, announced just as he sailed for Scotland, is that it is an expression of Mr. Carnegie's grateful remembrance of kindness shown to him years ago by Edwin M. Stanton, who, when secretary of war in President Lincoln's cabinet, made Mr. Carnegie assistant manager of posts and telegraphs. Mr. Carnegie's gift will be used to establish what is to be known as the Edwin M. Stanton chair of economics. Mr. Carnegie gave the money on learning that Mr. Stanton's early education had been secured at Kenyon College. The gift was partly due also to a suggestion from the late Senator Hanna, who had himself given $50,000 to the college to found a dormitory. Mr. Carnegie has always welcomed such opportunities to emphasize his various close relationships with the telegraphic field.

MR. WINSLOW H. HERSCHEL, who has been stationed at the Jerome Park Reservoir, Aqueduct Department of New York City, has sailed for Europe on behalf of the Allis-Chalmers Company. He will remain on the other side for a year, making his headquarters at Zurich, where he will act as local agent and technical correspondent for the company. The works of Escher, Wyss & Co. are located at Zurich. As previously mentioned in these columns, the Allis-Chalmers Company has acquired the American rights for the Swiss concern's water turbines. Mr. Clemens Herschel, M. Am. Soc. C. E., formerly hydraulic engineer of the Holyoke, Mass., Water Power Company, also consulting hydraulic engineer from time to time during the past score of years for several Niagara water power companies, has charge of the new water turbine and other hydraulic machinery department of the Allis-Chalmers Company.

MESSRS. KEMPSTER B. MILLER AND S. G. McMEEN, two of the best known telephone engineers of Chicago, have become associated as consulting engineers, experts and solicitors in patent causes, and will open offices at 1442 and 1443 Monadnock Block, Chicago, about May 1, 1904. As consulting engineers in the telephone field they will fill a place hitherto unoccupied even in such an important independent telephone center as Chicago. Mr. Miller needs no introduction as a telephone engineer. He is a graduate of Cornell. After several years in the U. S. Patent Office as examiner of telephone patents he left to become one of the pioneer independent telephone manufacturing company engineers with the Western Telephone Construction Company of Chicago. He left that company to accept a much higher salary as instructor in telephony for the International Correspondence Schools, where he remained a year. About four years ago when the Kellogg Switchboard and Supply Company was started he took an important engineering position with that company which he has held ever since. His book on "American Telephone Practice" is recognized as the standard work on telephone circuits and switching, being the only comprehensive book of the kind in the field. Mr. S. G. McMeen is best known through his long connection with the Central Union Telephone Company as chief engineer and assistant engineer. Graduating from Purdue in 1895, he went at once into field work for the Central Union Telephone Company. In 1893 he became assistant chief engineer, and later chief engineer, until 1902, when he took charge of the telephone central office and exchange equipment work for the Western Electric Company, where he has been for the two years just past. It would be hard to find two engineers better fitted by all around experience and personal acquaintance to enter the telephone consulting field than Messrs. McMeen and Miller, and the industry is to be congratulated on having available such talent outside of the manufacturing companies. It is a good thing for the business.

Trade Notes.

OIL FILTERS.—The American Ship Building Company has given a second order for Cross oil filters for its yards at Lorain, Ohio.

THE BOSSERT ELECTRICAL CONSTRUCTION COMPANY, of Utica, N. Y., has increased its capital stock from $75,000 to $100,000.

THE BUFFALO STRIKE.—The strike of electrical workers at Buffalo, N. Y., has been settled by a complete backdown of Local Union I. B. E. W., in regard to all the vital points at stake.

AUTOMOBILE MOTORS.—The Elwell-Parker Electric Company, Cleveland, O., has recently closed a contract for a large number of automobile motors, and the company is building a number of 200-hp heavy-duty hoisting motors.

SALUS COMPOUND.—The Electric Appliance Company, Chicago, is anxious to tell the world about "Salus Compound," which is the insulation that it claims makes the Packard transformer so effective. It has literature on the subject and will be glad to send it to any address.

MILLING MACHINES.—The Hess Machine Company, Fifteenth and Chestnut Streets, Philadelphia, in a pamphlet just issued describes and illustrates its line of milling machines and cutters for large output. The company furnishes electric motor drive, designed to suit each individual case, and the company has on hand designs suited for direct, alternating and multivolt motors, low and high speed.

DINKEY VENTILATED CONTROLLERS.—A very handsome and complete illustrated catalogue has been issued by the manufacturers of the Dinkey ventilated controllers, the Electric Controller & Supply Company, of Cleveland, O. The construction is shown complete and in detail of this apparatus for cranes, the original type of which was brought out at the Homestead Steel Works of the Carnegie Steel Company to meet the special requirements of steel works. The catalogue is known as Bulletin No. 9.

HAND PORTABLE ELECTRIC DRILLS.—E. H. Cadiot & Company, 12, Rue St. Georges, Paris, France, have made hand portable electric drills a specialty since 1896. They have sent us a new catalogue of these machines, whose object is to enable small drill holes to be made in any kind of material or machinery which cannot be easily transported to large electric drilling machines. These small drills have met a steady and increasing sale. Messrs. Cadiot have recently introduced some powerful machines of this class, which, however, retain all their portable features and are in every way up to date.

THE NERNST LAMP COMPANY has recently established district offices at St. Louis, Mo., and Denver, Col. The St. Louis office, embracing the southwest territory, is located at 908 Pine Street, with Mr. H. M. Reed as district sales manager. The Denver office, covering the middle western territory, is at 1619 Glenarm Street, with Mr. F. D. Marthens as district sales manager. These offices will carry a complete stock of Nernst lamps and supplies, and will be provided with an attractive exhibition room, in which will be shown the different types of Nernst lamps in actual operation and in comparative tests with other illuminants.

REMODELING OF POWER PLANT.—The Canadian Rubber Company of Montreal recently remodeled its power plant and found that the tall brick chimney, 110 feet high, would not give the proper amount of draft necessary in connection with the four new Stirling boilers it was to install. Mechanical draft was necessary, and for this purpose a large Sturtevant horizontal engine was installed, and now the proper amount of draft is easily attained and regulated at will regardless of the weather conditions. This installation is another illustration of the necessity of mechanical draft, especially in connection with the remodelling of old boiler plants.

HOW TO MAKE INDICATORS, reducing wheels and planimeters and how to use them intelligently from the first lesson to the last, is a line of instruction which any progressive engineer should be interested in. Such a course is being offered by the Indicator Instruction Company, No. 19 Franklin Avenue, Scranton, Pa. This is a concise, practical course of instruction, as it covers the subject in twenty-four pages from the making of the patterns to the construction and testing of an indicator spring. The company is making a special offer for enrollments received prior to April 15 and offers to send prospectus and all particulars free to those interested. Mr. A. C. Lippincott is the instructor.

THE NATIONAL-ACME MANUFACTURING COMPANY, Cleveland, O., manufacturer of the Acme automatic multiple spindle screw machine and parts produced on this machine, has recently found it necessary to add a night shift in its products department. The speed and accuracy of its Acme machine enables it to rapidly produce special milled work from steel, iron and brass, and the company has been particularly successful in securing business of this class from telephone, battery and electrical instrument manufacturers. Its business in the machine tool line is fully up to that of last year. An interesting machine recently shipped by this company was a multiple spindle screw machine for producing caulks for cavalry horses for the Japanese army—an instance of the careful attention which the "Yankees of the East" are giving to the most minute details in the care of their army equipment.

THE ROSSITER, MacGOVERN Electrical Company, western agents of Rossiter, MacGovern & Co., has found it necessary, owing to the very large increase in its office staff, to move its offices from the Missouri Trust Building to its factory, corner Papin Street and Compton Avenue, St. Louis. The business under the active management of Mr. J. A. Peirce has increased immensely since the company was first organized, less than two years ago. Among recent contracts taken by this company is the complete installation of the power house of the Kokomo, Marion & Western Traction Company, Kokomo, Ind., calling for the complete installation of a power station of 1000 kilowatts. Everything is furnished, including engines, boilers, generators, pumps, etc., and two 150-kw motor-generator sets. The company is also installing one 500-kw direct-connected, direct-current 600-volt unit in the station of the Louisville Lighting Company, Louisville, Ky., besides having in hand a large number of the electrical exhibit installations at the Louisiana Purchase Exposition.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MARCH 22, 1904.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., New York.]

754,969. STORAGE BATTERY; Martin C. Burt, Chicago, Ill. App. filed Aug. 13, 1903. (See page 658.)

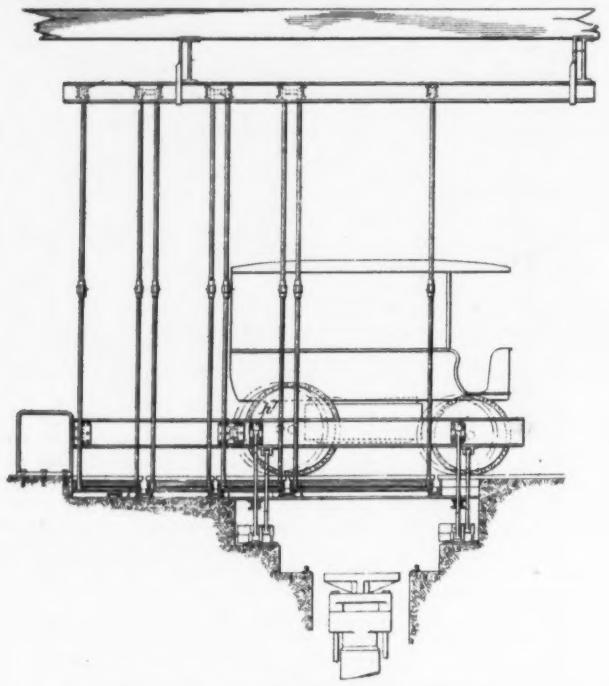
754,980. SYSTEM OF SPEED REGULATION FOR MOTOR-DRIVEN MACHINERY; Gano S. Dunn, East Orange, N. J. App. filed Aug. 20, 1903. A variable speed motor is combined with a number of trains of gears, the velocity ratio of the gear trains being proportioned so that the entire range of speed obtained with each successive train covers a portion of the range obtainable with the next succeeding train.

754,997. METHOD OF PROVIDING CABLES OR OTHER FLEXIBLE BODIES WITH SOLID ENDS; George G. M. Hardingham, London, England. App. filed Mar. 21, 1903. The cable is inserted in an opening in the head and a tool driven into another opening to force the metal into intimate contact with the cable.

755,029. ARMATURE WINDING OR COIL; Frank A. Merrick, Johnstown, Pa. App. filed Nov. 9, 1899. A form of coil intended to occupy small space at the heads of the armature.

755,032. APPARATUS FOR WIRELESS TRANSMISSION OF ENERGY; Daniel M. Moore, Newark, N. J. App. filed Apr. 18, 1903. The current is broken in a vacuum, the object being to create the waves or vibrations of radiant energy in a more economical and effective manner.

755,048. AUTOMATIC CIRCUIT CLOSER; James L. Russell, Boston, Mass. App. filed Nov. 2, 1903. A tubular walking-beam containing an expansible liquid is arranged near two lamps and controls the circuit of the lamps by oscillating from one position to the other by reason of the heating effect of the lamp upon the liquid contents of the beam.



755,087.—Positioning Apparatus for Vehicles.

755,087. POSITIONING APPARATUS FOR VEHICLES; George A. Ward, New York, N. Y. App. filed Dec. 23, 1902. The sections of a platform upon which the vehicle runs to receive its battery are movable by power devices so as to position the vehicle accurately with respect to the platform upon which the battery is deposited.

755,092. LINE WIRE CLAMP; Herman C. Willitz, Janesville, Wis. App. filed Oct. 17, 1903. A U-shaped spring plate adapted to clamp the wire and a link embracing and confining the ends of the clamp.

755,121. ELECTRICAL APPARATUS FOR THERAPEUTIC PURPOSES; Frederick C. Fisher, Bristol, Eng. App. filed Sept. 21, 1903. Details.

755,125. ALARM DEVICE; William Friedberg, New York, N. Y. App. filed Nov. 11, 1903. Details of a door knob circuit closer.

755,140. ELECTRIC RAILWAY SIGNAL; Bertram M. Kershner, Pittsburg, Pa. App. filed June 21, 1902. A signal wire extends over a block and is normally grounded at each end; the car automatically disconnects one end from the ground and connects it to a source of current supply to actuate the signal.

755,141. ELECTRICAL SWITCH MECHANISM; Hubert Krantz, Brooklyn, N. Y. App. filed June 29, 1903. A special arrangement of the cross-bars and bus-bars of a switchboard affording a saving in material in the construction.

755,142. STORAGE-BATTERY CONSTRUCTION; Simon Lake, Bridgeport, Conn. App. filed Dec. 17, 1903. (See page 658.)

755,165. ELECTRIC SWITCH; Ashley P. Peck, Milwaukee, Wis. App. filed Sept. 21, 1903. A switch having insulating barriers so arranged that when the ends of the movable contact leave the stationary contacts, they are practically inclosed in insulating material.

755,173. ELECTROPNEUMATIC SYSTEM OF DRIVING; Johann Sahulka, Vienna, Austria. App. filed Apr. 18, 1903. A compressor driven from the motor shaft charges an air tank, which supplies an air engine also connected to the axle. The electric motor acts as the main working motor, the air engine being used in starting going over sections of the track where there are no line conductors and in cases where an extra amount of power is required. A controlling device common to both motors enables one or the other motor to be thrown in or out.

755,203. ELECTROMAGNETIC RAIL BRAKE; Karl A. Wilde, Hamburg, Germany. App. filed Dec. 1, 1903. A plurality of pole pieces carrying brake shoes and having tubular extensions, detachably connected together for convenience in assembling and replacing the parts.

755,229. COIL FOR ELECTROMAGNETS OR OTHER PURPOSES; Friedrich Klingelfuss, Basle, Switzerland. App. filed Sept. 28, 1900. The wire layers are in discs perpendicular to the axis of the coil; the insulation being arranged so that its value between every two turns is proportional to the potential difference.

755,247. MANUFACTURE OF SULPHURIC ACID; Pedro G. Salom, Philadelphia, Pa. App. filed June 17, 1902. (See page 658.)

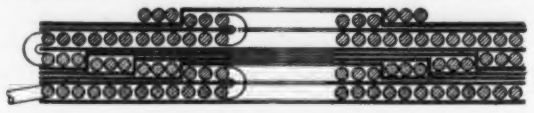
755,282. ELECTROMAGNETIC SEPARATOR; Myron Dings, Milwaukee, Wis. App. filed May 23, 1903. Details.

755,297. AUTOMATIC CIRCUIT BREAKER FOR ELECTRIC TIME OR OTHER SWITCHES; Arthur W. Hutchins, Providence, R. I. App. filed May 15, 1903. Details.

755,302. EXTRACTION OF COPPER FROM COMMINUTED MINERAL MIXTURES; Ernest A. LeSueur, Ottawa, Can. App. filed May 27, 1899. (See page 658.)

755,305. PEAKED WAVE WIRELESS TRANSMISSION; Daniel M. Moore, Newark, N. J. App. filed June 14, 1902. A method of setting up waves of radiant electric energy by producing changes of primary exciting electric potential which, if graphically described as a series of waves, would show waves of highly peaked form.

755,306. ELECTRIC TUBE LIGHTING; Daniel M. Moore, Newark, N. J.



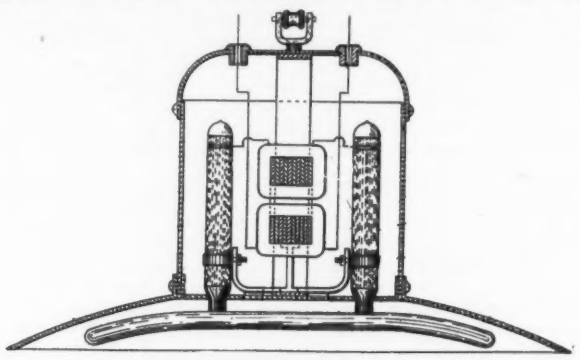
755,229.—Coil for Electromagnet or other Purposes.

App. filed Jan. 19, 1903. The leading-in wires of the tube are in direct connection with the terminals of the secondary of the transformer, the connection being made within a casing inclosing the transformer.

755,307. ELECTRIC TUBE LAMP; Daniel M. Moore, Newark, N. J. App. filed Feb. 6, 1903. A casing containing a transformer and the tubular lamp terminals, that portion of the tube used for lighting, extending through the walls of the casing.

755,320. APPARATUS FOR HEATING AIR; Walter K. Seelye, Dubuque, Iowa. App. filed June 13, 1902. Details of a resistance and valve apparatus for instantaneously heating air on its passage through a dental or other tool.

755,358. RETARDING DEVICE FOR ELECTRIC CIRCUIT BREAKERS; Algernon R. Cheyney, Philadelphia, Pa. App. filed Dec. 2, 1903. An



755,307.—Electric Tube Lamp.

automatic valve controlling the inlet of liquid to a chamber in which the core of the solenoid moves.

755,367. STATIC ELECTRIC MACHINE; Ernest E. Fewkes, Newton, Mass. App. filed June 1, 1903. One or more revolving non-charging generating plates and a revolving charging plate, equalizing combs for all the plates, and electrical connections between the equalizing combs of the charging plate and those of the generating plates.

755,382. DEVICE FOR TESTING ELECTRIC CURRENTS; Charles Oliver, Woolwich, England. App. filed Nov. 29, 1902. A low conductive pencil to be held in the hand is fitted with a sliding metallic cap adjustable in position to alter the resistance of the pencil.

755,391. ELECTRIC RAILWAY SHOE; Henry Rosenfeld, New York, N. Y. App. filed Aug. 19, 1903. The contact surface of the shoe has a V-shaped rib and is weighted to remove snow and ice from the rail.

755,393. ELECTRIC CONNECTION; Frank J. Russell, New York, N. Y. App. filed Nov. 6, 1903. Reversible bracket angle-plates are used to compensate for incorrect settings of terminal boxes in a wall.

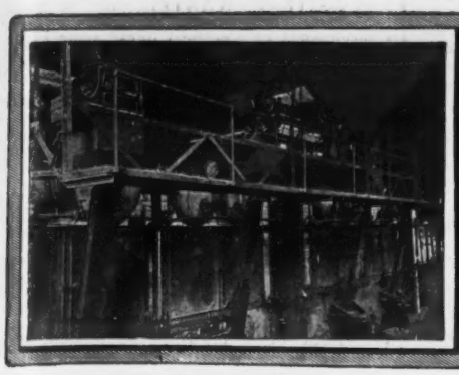
755,468. RHEOSTAT; Arthur C. Eastwood, Cleveland, O. App. filed Dec. 21, 1903. Wiring connections of a controller are avoided by mechanically fastening the contact fingers to a metal frame to which the resistance circuit is applied and connected.

755,514. FIRING MECHANISM FOR BREECH-LOADING GUNS; John F. Meigs and Sigard A. S. Hammar, South Bethlehem, Pa. App. filed Feb. 2, 1901. Details.

755,537. COIL FOR DYNAMO ELECTRIC MACHINES; Ferdinand Porsche and Ludwig Lohner, Vienna, Austria-Hungary. App. filed July 11, 1902. A coil wound of band conductors and having opposite sides or ends cut away to give it a concave-convex form to fit against the ring of a field magnet.

755,563. AUTOMATIC CONTROLLING DEVICE; Jacob S. Cole, Allegheny, Pa. App. filed July 15, 1903. An automatic switch adapted for electric cranes.

755,577. ELECTRIC VIBRATOR; William MacMillan, New York, N. Y. App. filed July 29, 1902. A circuit changer for vibrating bells in which the contacts are located in a closed box.



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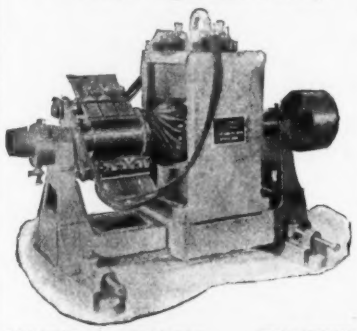

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(*Continued on Page 93.*)

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3	600	Card, M. P., compound	750
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1	700	Crocker-Wheeler, M. P., comp.	1085
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2	1800	Edison, 100-K.W., s-o., comp.	650
1	1800	Western Electric, M. P., comp., 6 pole, 100-K.W.	425
1	2200	Western Electric, M. P., 125-K.W., latest type, comp., 6 pole, 3 bearing. (Above machine can be arranged for direct connection also.)	225
2	2500	Western Electric, M. P., comp., 150-K.W., direct connected to 16x18 McEwen engine	240

220 TO 250 VOLT GENERATORS.

	K.W.		Speed.
1	7½	Holtzer-Cabot, compound	1350
1	9	New England, M. P.	1600
2	10	T.-H., D 10, oil cups	1600
1	12	Western Elec., M. P., comp.	750
1	15	Edison, self-oiler	1500
1	17½	Kester, comp.	1350
1	17½	Eddy, type C, comp.	1450
1	20	Edison, self-oiler, comp.	1400
1	20	Western Electric, comp., s-o.	700
1	20	Keystone, M. P., comp.	950
1	20	Eddy, M. P., comp.	825
1	20	Western Elec., M. P., comp.	650
2	30	C. & C., comp., self-oilers	800
1	40	C. & C., multipolar, comp.	750
1	40	Eddy, M. P., comp.	875
1	40	Commercial, M. P., d. c. to 11x12 automatic Chandler-Taylor engine	300
1	45	Edison, comp., self-oiler	1000
1	45	Am. Engine Co., M. P., comp.	700
1	45	Western Elec., M. P., comp.	550
1	45	C. & C., M. P., comp.	700
1	45	Gen. Elec., M. P., comp.	925
1	50	C. & C., compound	800
1	50	Commercial, M. P., comp.	775
1	50	Maine, M. P., compound	600
1	55	Fuller, multipolar, comp.	750
1	55	Eddy, M. P., comp.	750
1	60	Sprague, compound	500
1	60	Northern, M. P., comp.	800
1	75	Siemens & Halske, Churchward type, M. P., direct connected to 14x14 Ideal engine	300
1	80	C. & C., comp., self-oiler	625
1	100	Edison, comp., self-oiler	650
1	100	Commercial, M. P., comp.	675
1	125	Eddy, M. P., comp.	700
2	150	National, M. P., comp.	350
1	200	Eddy, multipolar, compound	500
1	250	Western Electric, 6 pole, type L, 3 bearing, compound	450
1	300	Western Electric, M. P., brand new	480

DYNAMOS ❁ MONEY SAVERS ❁ ENGINES

DIRECT CONNECTED UNITS

200-K.W. Thompson-Ryan, 125 volts, and McEwen tandem engine.
80-K.W. Jenny, 125 volts, and Russell 4 valve engine.
50-K.W. Northern, 125 volts, and Russell engine (new).
2—50-K.W. American Ball, 220 volts, and American Ball engines.
2—42-K.W. Westinghouse, 220 volts, and Alfrey engines.
30-K.W. Eddy, 125 volts, and Watertown.
25-K.W. Westinghouse, 125 volts, and Westinghouse engine.
7½-K.W. Northern, 125 volts, and Hill vertical engine (new).
6-K.W. Northern, 125 volts, and Hill vertical engine (new).
4-K.W. Northern, 125 volts, and Hill vertical engine (new).
3-K.W. Northern, 125 volts, and Hill vertical engine (new).

ENGINES

3—11 & 17 x 14 Harrisburg tandem.
1—11 & 19 x 24 Buckeye tandem, heavy duty.
1—16 & 30 x 48 Hamilton Corliss.
1—26 x 48 Vilter Corliss, rope drive.
1—24 x 48 Wright of Newburgh.
1—22 x 40 Nordberg, Rocker valve.
1—20 x 27 Russell, 4 valve.
2—20 x 48 Putman, 4 valve.
1—16 x 38 Watts-Campbell Corliss.
1—17 x 42 Brown of Fitchburg.
1—14 x 28 Delamater Corliss type.
1—13 x 14 Noye automatic.
2—13 x 12 Erie Ball automatic.
2—9½ x 10½ McIntosh & Seymour.
1—8 x 8 Climax automatic.

ALTERNATING (60 Cycle)

250-K.W. Westinghouse, 2 ph., 2200 v.
100-K.W. G. E., 3 ph., 2300 v.
75-K.W. G. E., single ph., 2200 v.
65-K.W. Stanley, 2 ph., composite.
20-H.P. Westinghouse, 2 ph., 220 v.
7½-H.P. Westinghouse type C, 220 v.
5-H.P. Westinghouse type C, 220 v.
2-H.P. Westinghouse type C, 220 v.
2-H.P. G. E., 3 ph., 104 v.

ALTERNATING (125 Cycle)

120-K.W. G. E., s. ph., 1100 v.
120-K.W. Westinghouse, 2200 v.
100-K.W. G. E., s. ph., Monocyclic.
2—A-70 T. H., s. ph., 1100 v.
1—60-K.W. G. E., A-10-60, 1100 v.
2—30-K.W. Westinghouse, 1100 v.
10-H.P. Excelsior, s. ph., 104 v.
3-H.P. Wagner, 104 v., s. ph.

110-125 VOLT GENERATORS AND MOTORS

2—66-K.W. G. E., 4 pole.
3—60-K.W. Edison bipolar.
2—45-K.W. Westinghouse, 4 pole.
1—40-K.W. C. & C., 4 pole.
1—35-K.W. Loomis, 6 pole.
1—35-K.W. Mather, 4 pole.
1—21-K.W. Riker, 4 pole.
1—17½-K.W. General Electric, 4 pole.
1—15-K.W. Edison bipolar.
1—12½-K.W. Card, 4 pole.
1—8½-K.W. Edison bipolar.
1—4½-K.W. Quaker City, bipolar.
1—3-K.W. Westinghouse.
Complete stock of motors.

220 VOLT GENERATORS AND MOTORS

1—120-K.W. C. & C., 6 pole.
1—175-K.W. Eddy, 4 pole.
1—40-K.W. Crocker-Wheeler, 4 pole.
1—22½-K.W. Churchward, 6 pole.
1—16-K.W. Ft. Wayne, 4 pole.
1—12-K.W. Keystone, 4 pole.
Complete stock of motors.

500 VOLT GENERATORS AND MOTORS

Boilers **THOMPSON SON & CO., 114 LIBERTY ST., N. Y.** Equipments

MODERN ELECTRICAL MACHINERY FOR SALE.

DIRECT CONNECTED UNIT, 220 volts

50-K.W. American Ball Dynamo & Engine.

110 VOLTS DIRECT CURRENT
Dynamos or Motors

30-K.W. Bullock, M. P.
15-K.W. Eddy, M. P.
10-K.W. Eddy, M. P.
5-K.W. C. & C.
3-K.W. C. & C.
2-K.W. Lundell.
1-K.W. C. & C.

500 VOLTS DIRECT CURRENT
Dynamos or Motors

15-H.P. General Elec., M. P.
7½-H.P. General Elec., M. P.
5-H.P. Sprague.
2-H.P. General Elec.

220 VOLTS DIRECT CURRENT
Dynamos or Motors

40-H.P. Sprague, M. P.
25-H.P. Crocker-Wheeler, M. P.
20-H.P. Card.
15-H.P. Sprague, M. P.
10-H.P. General Elec.
10-H.P. Holtzer Cabot.
7½-H.P. Card.
7½-H.P. Edison.
7½-H.P. C. & C.
5-H.P. Paragon, M. P.
5-H.P. Holtzer Cabot.
5-H.P. Crocker-Wheeler.
3-H.P. Diehl.
3-H.P. C. & C.
2-H.P. General Elec.
2-H.P. Diehl.
1½-H.P. C. & C.
1-H.P. Crocker-Wheeler.

ALTERNATING INDUCTION MOTORS

2 Phase, 60 Cycles, 220 Volts

30-H.P. Type F Westinghouse.
15-H.P. Type C Westinghouse.
10-H.P. Type C Westinghouse.
7½-H.P. Type C Westinghouse.
5-H.P. Type C Westinghouse.
2-H.P. General Elec.
1-H.P. Westinghouse.
½-H.P. General Elec., 220 or 110 v.
¼-H.P. General Elec.

2 Phase, 440 Volts, 60 Cycles

30-H.P. Westinghouse.
15-H.P. Westinghouse.
10-H.P. Westinghouse.
7½-H.P. Westinghouse.
5-H.P. Westinghouse.
3-H.P. Westinghouse.
1-H.P. Westinghouse.

3 Phase, 60 Cycles

5-H.P. Westinghouse, 220 volts.
2-H.P. Gen. Elec., 110 volts.
2-H.P. Westinghouse, 220 volts.
½-H.P. General Elec., 220 volts.
½-H.P. General Elec., 110 volts.

1 Phase, 60 Cycles

7-H.P. Wagner, latest type.
½-H.P. General Elec.
¼-H.P. General Elec.

1 Phase, 125 Cycles

3-H.P. Wagner, latest type.
1-H.P. General Elec.
⅓-H.P. Emerson.
1/10-H.P. Emerson.
Large stock of small motors, autostarters, starting boxes, rheostats, switchboards, voltmeters, ammeters, etc.

I BUY, RENT AND INSTALL.—GEORGE BENDER, 137 CENTRE STREET, NEW YORK.

ELECTRIC LOCOMOTIVES.

	Ton.		
1	10	Morgan-Gardner, type M, 250 v., direct current, double motor locomotive, 74-K.W., 42-inch gauge, speed 6 to 10 miles per hour	
1	17	Morgan-Gardner, type N, 250 v., direct current, double motor locomotive, 115-K.W., 40-in. gauge, speed 8 miles per hour	

500 TO 550 VOLT GENERATORS.

	K.W.		Speed.
1	60	Edison, comp., self-oiler, new armt. and commutator	800
1	62	T.-H., D 62, s-o., comp.	900
1	75	Akron, M. P., 6 pole	900
1	75	Bullock, multipolar	900
2	75	General Electric, M. P. 4, comp., new rewound	700
1	100	Siemens & Halske, 4 pole, with bar-wound armature, compound	600
2	100	Edison, compound	650
1	100	Gen. Elec., M. P. 4, comp.	650
1		General Electric slate panel switchboard for above, complete with ammeter, circuit breaker and resetting device, main line switch, rheostat switch, bus-bar connections, etc.	
2	120	Westinghouse, M. P., comp.	625
1	200	Thompson-Ryan, M. P., comp., three bearings	525
1	200	General Electric, M. P. 4, comp., s-o., 3 bearings, new commutator	400

ARC DYNAMOS.

	Lt.	C.P.		Speed.
1	35	2000	T.-H., L D 2 ball	820
1	45	1200	Brush, No. 7	1050
1	50	1200	T.-H., L D 12, new ball	820
2	50	2000	T.-H., M. D 2, s-o., ring	820
1	65	2000	Brush, No. 8	950
1	75	1200	T.-H., M D 12, s-o.,	820
1	75	1200	Wood	950
1	100	2000	Wood	600
1	125	1200	Brush, 6.6 amp.	700
2	125	2000	Brush, 9.6 amp.	500
1	125	1200	Excelsior	700

220 TO 250 VOLT MOTORS.

	H.P.	DIRECT CURRENT.	Speed.
1	1	General Electric, type I B	1025
1	1½	Commercial, self-oiler	1200
1	2	Lundell, newly rewound	1000
1	2½	Riker, s-o., with extra armt.	1460
1	3	C. & C.	1400
1	3	Bernard, M. P.	1525
1	3	Gibbs, M. P.	1400
1	3	Lundell, self-oiler	1500

BARGAINS IN (second-hand) ELECTRICAL MACHINERY

We do not offer old, worn out machines fit for the Junk pile, but the LATEST TYPES of the leading manufacturers.

GREGORY ELECTRIC CO.
54-62 S. CLINTON ST. CHICAGO.

Send for our Monthly Bargain Sheet showing NET prices—all machines fully guaranteed.

2	1	General Electric, 110 volts	1800
3	3	Western Electric, M. P.	1000
3	3	Westinghouse, M. P.	1700
1	3	Storey, variable speed	300-1500
1	3½	Eddy, M. P.	400
1	4	Commercial, M. P.	450
2	5	Gibbs, M. P.	1400
3	5	Hobart, M. P.	1050
5	5	Western Electric, M. P.	950
1	5	Eddy, M. P.	300
3	5	Belknap, M. P.	230
2	5	Crocker-Wheeler special printing press motors, direct con.	318
1	6½	Jenny, M. P., back geared, speed of shaft	440
1	7½	Waddell-Entz, M. P.	900
1	7½	Edison	1350
1	7½	Towle, M. P.	1600
1	7½	Western Electric, M. P.	1150
2	7½	Western Electric, M. P.	950
1	7½	Milwaukee, M. P., series, crane type, grease cup	600
1	8	Holtzer-Cabot	1250
1	8	Crocker-Wheeler, series, crane type	900
1	8	Maine, M. P.	200
1	10	Standard, M. P.	670
1	10	C. & C., M. P., enclosed	1100
1	10	Keystone, M. P., enclosed	1175
1	10	Western Electric, M. P.	800
1	10	Story, M. P., enclosed	600
2	10	Westinghouse, M. P.	1250
3	10	Bernard, M. P.	130
1	12	C. & C., self-oiler	1100
1	15	Keystone, M. P.	1570
1	15	New England, M. P., 8 pole	650
1	15	Western Electric, M. P	625
1	18	Edison, 15 K.W.	1150
1	20	Eddy	1300
1	20	Kester	1250
2	25	Edison, self-oilers	1100
1	25	Western Electric	525
1	25	Keystone, M. P.	850

	H.P.		Speed.
1	25	Eddy, M. P.	725
1	25	Western Electric, M. P.	550
2	40	C. & C., self-oilers	650
1	40	Sprague-Lundell, M. P.	625
1	50	C. & C. multipolar	650
1	50	Eddy, M. P.	675
1	50	Am. Engine Co., M. P.	565
1	60	C. & C., self-oiler	600
1	60	Edison, self-oiler	750
1	60	Commercial, M. P.	600
1	60	C. & C., M. P.	560
1	60	Maine, M. P.	500
1	60	Western Electric, M. P.	425
1	60	General Electric, M. P.	800
1	65	Eddy, M. P.	650
1	70	Fuller, multipolar	600
1	75	Sprague, self-oiler	450
1	75	Northern, M. P.	700
1	85	Western Electric, self-oiler	500
1	100	C. & C., self-oiler	450
1	125	Edison, self-oiler	550
1	135	Commercial, M. P.	675
1	150	Eddy, M. P.	600
2	200	National, M. P.	300

500 TO 550 VOLT MOTORS.

	H.P.		Speed.
1	1	General Electric, C. A.	1200
1	1½	Belknap, self-oiler	1700
2	1½	Northern, series	1400
2	1½	Crocker-Wheeler	1550
1	2	Maine, M. P.	1100
1	2½	Bain, self-oiler	2100
1	2½	New England	1500
1	3	C. & C., self-oiler	1600
1	3	General Electric, type C E	1800
1	3	Maine, M. P.	1100
1	3	Jenny, M. P., back geared, speed of shaft	240
1	3½	Roth	1700
1	3½	Roth, M. P.	950
1	3½	Westinghouse, M. P.	1050

	H.P.		Speed.
1	4	Edison, 3 K.W.	1700
4	4	Maine, multipolar	550
1	4	Bernard, M. P.	550
1	5	Hobart, self-oiler	1600
1	5	Fort Wayne	1400
2	5	Triumph, M. P.	1250
3	5	Crocker-Wheeler	950
1	6	C. & C., enclosed	1030
2	6	T.-H., D 5, self-oilers	1800
2	7½	Thomson-Houston, D 7½	1600
1	7½	Roth, self-oiler	1400
1	7½	Card, multipolar	775
1	7½	Jenney, M. P.	1500
1	7½	C. & C., M. P., compound	1160
3	7½	Crocker-Wheeler	1500
1	7½	Eddy, M. P.	875
1	10	Phoenix, M. P.	950
1	10	Crocker-Wheeler	1275
1	10	Northern, M. P.	1350
1	10	Triumph, M. P.	1100
2	10	General Electric, M. P.	1400
1	10	Perrett, M. P., compound	600
1	10	Eddy, M. P.	650
3	10	Belknap, M. P.	500
1	12	Am. Engine Co., M. P.	1365
1	15	Eddy, self-oiler	1725
1	15	C. & C., self-oiler	975
1	15	Edison	1275
1	15	Perrett, M. P.	1100
1	15	Maine, M. P.	450
1	20	Eddy, self-oiler	1500
1	20	Perrett, M. P.	700
1	20	Holtzer-Cabot, M.P., enclosed	1150

ALTERNATING CURRENT MOTORS.

SINGLE PHASE. 125-133 CYCLES.

	H.P.		Speed.
10	½	Stanley, 100-110 volts, new	2400
1	½	Holtzer-Cabot, 104 volts	2500
1	½	Emerson, 104 volts	2000
1	½	Wagner, 104 volts, aut.	2000
1	1	Fort Wayne, 104 volts	2500
1	1	Wagner, 208 volts, aut.	2000
1	1½	Wagner, 208 volts, aut.	2000
1	3½	Wagner, 110 volts, automatic	1875

THREE PHASE. 125-133 CYCLES.
For Monocyclic System.

	H.P.		Speed.
1	3	General Electric, 110 volts	1875

SINGLE PHASE. 60 CYCLES.

	H.P.		Speed.
2	½	Phillips, 104 volts	1800
1	½	General Electric, type I S, 110 v., with type K. S. condenser-compensator, new	1800
1	¾	Gen. Elec., type I. S., form L	1800
1	1	Phillips, 208 volts	1600
1	1	Phillips, 104 volts	1600
1	2	Wagner, 500 volts, aut.	1800
1	2	Wagner, 104 volts	1800
1	15	Wagner, 104 volts, aut.	1200
2	30	Wagner, 104 volts, automatic	1200

For Sale:—Four 22' and 42' x 48'

Hamilton Tandem Compound Condensing Corliss Engines

With Independent Condenser for Each. Wheels: 24 ft. x 50 ins. 60,000 lbs. Capacity: 750 to 1,000 H. P. Each. Located in New York City.

900-H.P. 34x60 International Power Corliss.
450-H.P. 16 and 30x42 Allis Compound Corliss.
450-H.P. 24x48 Brown Corliss.
400-H.P. 23x60 Geo. H. Corliss.
300-H.P. 20x48 Harris Corliss.
275-H.P. 20x42 Hamilton Corliss Engine.
225-H.P. 18x42 Hamilton Corliss.
200-H.P. 18x36 Bates Corliss.
200-H.P. 12 and 22x42 Atlas Compound Corliss.
175-H.P. 16x42 Allis Corliss.
150-H.P. 15x38 Brown Corliss.
125-H.P. 14x36 Putnam Corliss.
100-H.P. 12x36 Harris Corliss.
85-H.P. 12x30 Lane and Bodley Corliss.
650-H.P. 28½x52 Buckeye Automatic.
450-H.P. 24x48 Buckeye Automatic.
400-H.P. 16½ and 28½x27 Buckeye Compound Automatic.
250-H.P. 16 and 27x16 Westinghouse Compound.
100-H.P. 13x12 Ideal S. O. Automatic.
90-H.P. 12x20 Atlas Side Crank Automatic.
90-H.P. 12x16 Erie Center Crank Aut.
40-H.P. 9x13 Frost Side Crank Automatic.

BOILERS

1—350-H.P. Babcock and Wilcox Boiler, 150 lbs.
1—280-H.P. Babcock and Wilcox Boiler, 150 lbs.
2—265-H.P. Babcock and Wilcox Boilers, 150 lbs.
3—265-H.P. Babcock and Wilcox Boilers, 135 lbs.
1—175-H.P. Babcock and Wilcox Boiler, 125 lbs.
1—172-H.P. Babcock and Wilcox Boiler, 130 lbs.
1—250-H.P. Cahall Vertical Boiler, 160 lbs.
14—72x22 Tubular Boilers, 115 lbs.
7—72x18 Tubular Boilers, 120 lbs.
7—72x18 Tubular Boilers, 100 lbs.
3—72x16 Tubular Boilers, 100 lbs.
8—66x18 Tubular Boilers, 100 lbs.
3—66x16 Tubular Boilers, 100 lbs.
1—60x18 Tubular Boiler, 100 lbs.
4—60x16 Tubular Boilers, 100 lbs.
2—60x14 Tubular Boilers, 120 lbs.
Cookson Heaters, 50, 75, 100, 150 and 200 H.P.

WHITEHEAD MACHINERY CO., Davenport, Iowa.
Eastern Office, 517 Park Building, Pittsburgh, Pa.

60 CYCLE ALTERNATORS.

2—150-K.W. Westinghouse 60 cycle Alternators, single phase, direct connected to compound engines.
1—180-K.W. General Electric, 60 cycle, two phase Alternator.
1—120-K.W. Westinghouse, 60 cycle, two phase Alternator.
2—120-K.W. General Electric, 60 cycle, single phase Alternators.
360-K.W., 150-K.W., 120-K.W. and 75-K.W. sizes in 125 cycle Alternators.

DIRECT CURRENT GENERATORS.

1—100-K.W. General Electric, 8 pole, 125 volt Generator, direct connected to 15½x15 engine.
1—250-K.W. Walker, 6 pole, 250 volt Generator.
1—250-K.W. Western Electric Railway Generator.
7—Edison B. P., 175 and 100 K.W.

ENGINES.

1—Brand new 18x16 American Ball Automatic Engine, ready to ship.
1—16 and 30x48 Cooper Cross-compound Condensing Corliss.
1—24x48 Hamilton Double Eccentric Corliss.
1—22x48 Allis Corliss, with heavy sectional band wheel.
1—24x20 Ideal Automatic, latest type.
1—15 and 25x16 Cross-compound Erie Ball Automatic.

Write for list No. 42 of Dynamos, Engines and Boilers.

STATION EQUIPMENT COMPANY, 204 DEARBORN ST., CHICAGO.

FOR SALE.

DIRECT CONNECTED.

30-K.W. Eddy dynamo to Watertown engine, 110 volts.
10-K.W. Westinghouse dynamo to Armington & Sims engine, 110 volts.
10-K.W. Westinghouse dynamo to Westinghouse engine, 110 volts.
80-Amp. Edison dynamo to Brotherhood engine, 80 volts.
20-H.P. Elektron 220 volt motor to Morse Williams freight elevator.

BELTED.

60-amp. Crocker-Wheeler to Herresoff engine, 110 volts.
2000 volt Electro Dynamic arc dynamo, 10 amperes.
500-Lt. Edison dynamo, 110 volts.
60-amp. Westinghouse dynamo to Westinghouse engine, 110 volts.
35-amp. Sprague dynamo to Hornby Ackroyd oil engine.
600-Lt. Weston dynamo, 110 volts.
500-Lt. Edison Dynamo, 110 volts, D.C. to Brotherhood engine.
400-Lt. Excelsior dynamo, 110 volts.
45-H.P. C. & C. motor, 230 volts.
30-H.P. C. & C. motor, 230 volts.
15-H.P. Thomson-Houston motor, 500 volts, with spare armature.
15 General Electric, 2-H.P., 220 volt motors.
12 Siemens & Halske 5-H.P., 220 volt motors, 220 volts, 1550 R.P.M.
2 search lights.

These motors are dust proof and series wound.

Large stock of smaller dynamos and motors.

Repairing of electrical machinery in all its branches.

JORDAN BROS., 74 Beekman St., N. Y.

DIELECTROL

A permanently plastic coil cement, moisture and FOOL PROOF

(4) DIELECTRIC MNFG. CO., SAINT LOUIS

LOUIS HECK,

Successor to STUCKY & HECK, ELECTRICAL MANUFACTURING CO., Lit'd.

Electrical and Mechanical Engineers and Draughtsman

Every System—Repairing, Re-winding, Re-construction

Telephone No. 977

35 N. J. RAILROAD AVE., Opp. Market St. Railroad Depot, NEWARK, N. J.

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MOTORS FOR SALE

75 H.P.

Several direct-current, 250-volt, slow-speed, compound-wound Crocker-Wheeler motors for sale.

D'OLIER ENGINEERING CO.,
119 So. 11th St., Philadelphia, Pa.

FOR SALE OR TRADE.

35-H.P. 230-volt Western Electric motor, $225.00
2-H.P. 500-volt T. H. motor, $45.00.
75 light, 110-volt Westinghouse dynamo, $70.00.
125 light, M. P., Ruprecht, 110 volts, $90.00.
3-H.P. Mather, 500 volts, $40.00.

The Standard Machinery & Equipment Co.
410 Electric Building, Cleveland, Ohio.

British Colony of Natal, South Africa

Equipment of Ground and First Floors of Railway Customs Bonded Warehouse, Port Natal, with a Complete System of Electric Telpherage.

THE GOVERNMENT OF NATAL is prepared to receive Tenders for the Supply, Erection and Completion (including maintenance for 3 months) of the above Plant.

Plans, Outline Specification, Conditions, and Form of Tender may be obtained on payment of Five Guineas, from Sir Walter Peace, K.C.M.G. Agent General for Natal, 26 Victoria Street, Westminster, London, S. W., or from Charles J. Crofts, M. Inst. C. E., Harbor Engineer, Natal. The deposit will be returned on receipt of a bona fide Tender.

Tenders in sealed cover, endorsed "Tender for Electrical Equipment of Railway Customs Bonded Warehouse, Port Natal," are to be furnished in duplicate, addressed to the Agent General as above, or to the Chairman, Tender Board, Pietermaritzburg, Natal. Tenders close both in London and Natal on the 9th May, 1904.

The Government of Natal does not bind itself to accept the lowest or any tender.

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Copies must be clean and well preserved; will pay face value. Address No. 1372, care Electrical World and Engineer, New York.

PROPOSALS

In virtue of a resolution of the Municipal Council of San Luis Potosi, approved by the superior Government of the State, contractors for electric lighting are invited to present their propositions for the public illumination of this city, with the understanding that the contract that may be made shall be based upon the following clauses:

I. The contractor by himself, or through the company or companies he may organize, shall establish in this city an Electrical Plant according to the latest and most adequate system in the opinion of such experts as the commission of this department shall duly appoint.

II. He shall be bound to establish by the last day of the present year the service of the illumination with a number of arc lights which shall not be less than one hundred and fifty, distributed according to the plan which shall be given him by the commission of illumination, who shall have the power to modify this distribution whenever it should be necessary within a reasonable term determined by same.

III. These lights shall illuminate daily from the setting of the sun until its rising on the following day.

IV. The contract shall be made for no less than fifteen years, and shall not be rescindable, except in the cases provided for by the law or by mutual consent between the contracting parties.

V. The price per light or for all the lights contracted for, shall be paid by the Municipal Council at the end of each month.

VI. The enterprise that shall have the preference shall make use of the streets, squares and other public places for their conductors, etc., in accordance with the respective commissions taking in consideration the concessions granted previously. Their plant shall be established outside of the perimeter marked out by the respective commissions.

VII. Said enterprise, within a month after the acceptance of their propositions, shall guarantee the fulfilment of their obligations by making a deposit of five thousand pesos in favor and to the satisfaction of the Municipal Council.

VIII. In said propositions mention must be made of the systems adopted for the lighting and installations, the power of each light and apparatus to show same, the price asked for, and, in short, all the details of the business.

IX. Upon making the agreement, details shall be also given as to the terms to be adopted, the capital to be paid out, the streets and other public places that may be used and penalties for the contracting parties, etc., etc.

X. This convocation shall be closed on the fifteenth of May of the present year and shall be published in the Republic as well as in the United States and in Europe.

San Luis Potosi, Mexico, Feb., 1904.
(Signed) Enrique Milán, Sec'y.

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1—150-K.W. 110-volt MP 6 engine type General Electric generator direct connected to one 14 and 21x36 Penna. Iron Works tandem compound Corliss engine, 102 R.P.M.

2—150-K.W. 125-volt MP 8 150-225 R.P.M. latest type vertical split frame Westinghouse generators direct connected to two 18x16 simple horizontal 4-valve Corliss type steam jacketed cylinder Ball & Wood engines. These outfits are brand new. Immediate delivery.

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1—75-K.W. 125-volt MP 6, latest engine type Westinghouse generator, 275 R.P.M., direct connected to one 13x12 Ball & Wood centre crank, high speed automatic, simple engine.

1—60-K.W. 125-volt MP 6 60-280 R.P.M. engine type General Electric generator, direct connected to 12x12 Armington & Sims horizontal, centre crank, high speed, automatic engine, with new type governor.

1—62½-K.W. 250-volt MP 6 engine type Bullock generator, 275 R.P.M., direct connected to 14x12 Ames horizontal, centre crank, high speed, automatic engine.

1—50-K.W. 125-volt MP engine type G.I. generator, 300 R.P.M., direct connected to one 12x12 horizontal high speed Russell engine, with Rites governor. Brand new.

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(*Continued from Page 90.*)

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POSITION WANTED.—By young man, good technical education; extensive experience installing and operating electric light, pumping and refrigerating plants, line construction and house wiring; able mechanic; small salary. Address No. 1398, care Electrical World and Engineer, New York.

POSITION WANTED.—By young man, technical graduate, with 5 years' experience in steam plant and shop work. Address No. 1401, care Electrical World and Engineer, New York.

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The rate for "Help Wanted" advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each, payable in advance. Remittance and copy should reach this office not later than Tuesday morning for the next succeeding issue.

WANTED.—A man 31 years of age, with 5 years' experience as manager of combined electric light and gas companies in a town of 10,000 population would like to change his position about July 1; good references given. Address No. 1395, care Electrical World and Engineer, New York.

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WANTED.—Machinist; a first-class foreman, for new electrical manufacturing concern, who is familiar with electrical instruments and devices, such as telephone and telegraph instrument parts. Address No. 1392, care Electrical World and Engineer, New York.

WANTED IMMEDIATELY.—Competent foreman to take charge of work on switchboards and panel boards; must be thoroughly familiar with the work and have had practical experience in working to drawings; give experience, references and salary expected. Address No. 1397, care Electrical World and Engineer, New York.

WANTED.—An experienced editor for a Technical Magazine; one who has held a chair in Electrical, Mechanical or Civil Engineering, and in addition has had practical shop experience; state experience and salary expected. Address No. 1403, care Electrical World and Engineer, New York.

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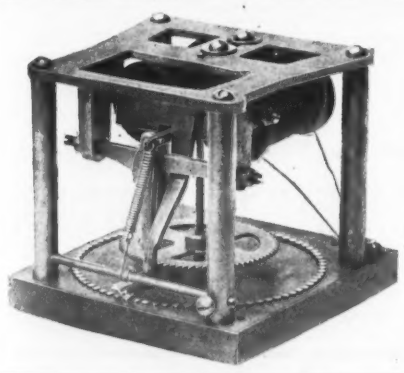

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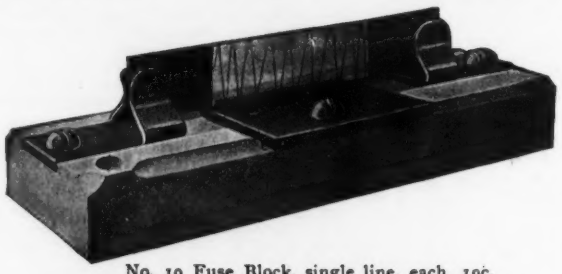

No. 10 Fuse Block, single line, each, 10c.
In lots of 100, 10% discount.

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No. 10 and No. 12 Fuse Blocks are presented with the knowledge that no better telephone protector can be furnished at any price, and that they are the only well made, highly efficient protectors sold at a low price.

Our "Gilgen Patent Fuse," used in No. 10 and No. 12 Fuse Blocks, is so constructed as to give six inches of fuse and eight saw teeth points within 1-32 inch of ground plate, giving all the advantages possessed by carbon arresters without the disadvantage of continual attention to prevent grounding lines. Fuse is also made of special metal, always retaining same ampere capacity, and acts as a highly efficient sneak current, or lightning protector.

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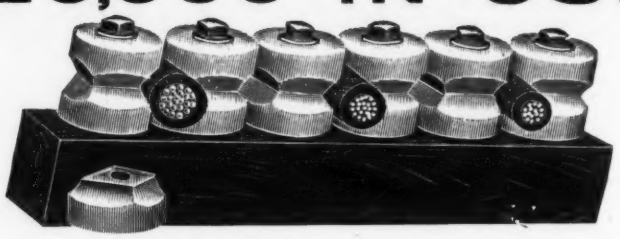

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subscribers' drops were put up with wood brackets spiked to brick walls.

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Drill Chuck Sliding Hammer Hollow Punch

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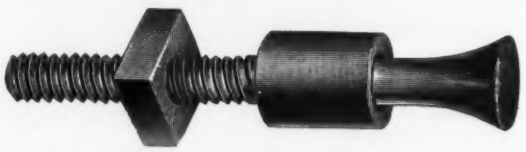
is a steel tool with collars 15 inches apart. One end holds the drill, the other end is a hollow punch. Between the collars is a 4lb. sliding hammer. Holding the drill point against a brick wall and striking quick sharp blows with the sliding hammer, drills a 1-4 inch hole 1 inch deep in

15 Seconds.

The Peirce Expansive-Lead Bolt

is inserted in the hole head first, and by use of the punch end of the hammer-drill, the lead sleeve is forced back over the wedge shaped head and expanded into every crevice of the masonry.



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are easily attached to the bolts by means of nuts.

To drill holes, force in bolts, put up bracket and screw home nuts requires

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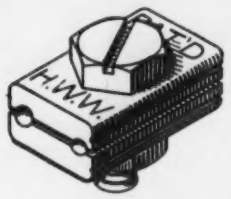

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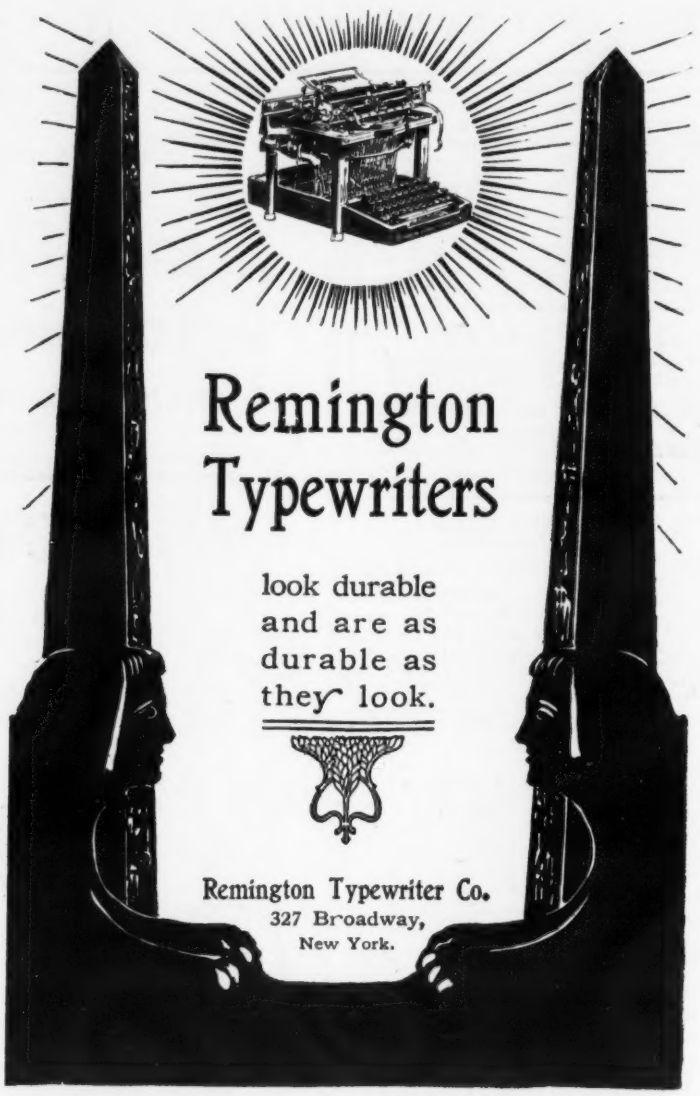

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Angle	16	" "
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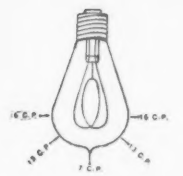

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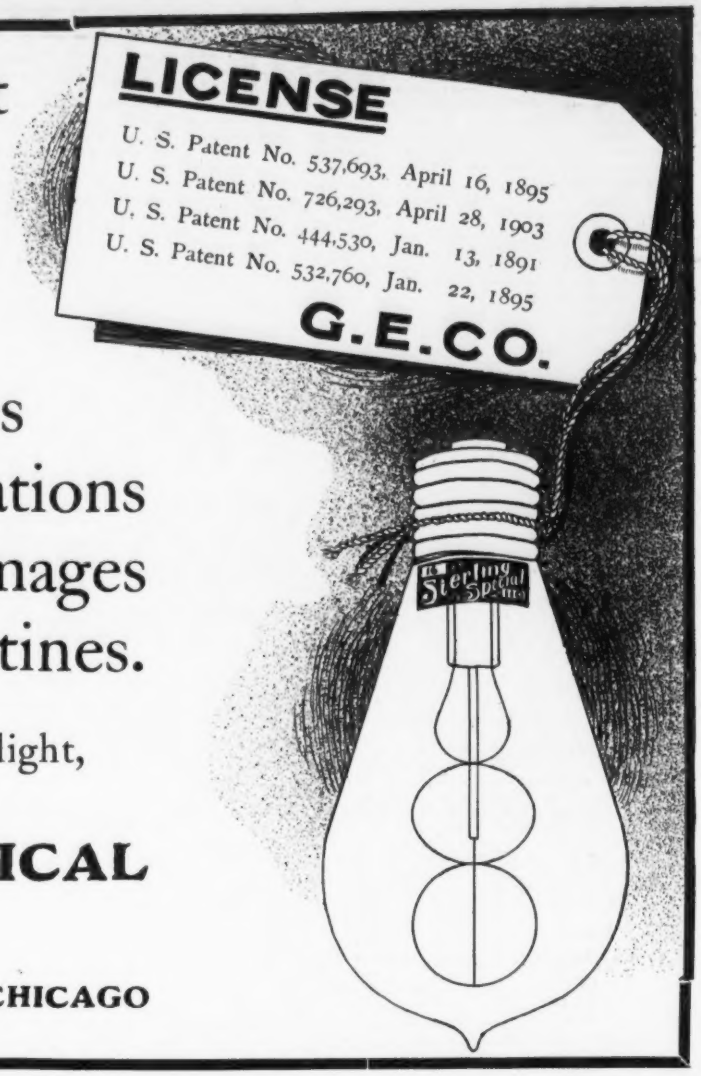
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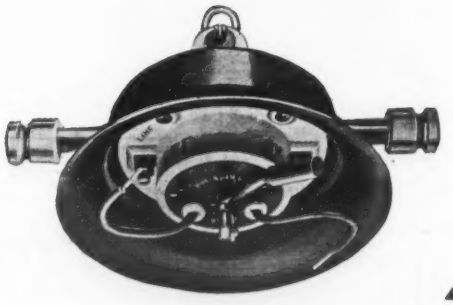

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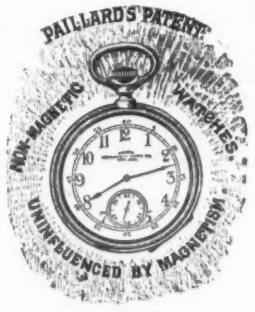

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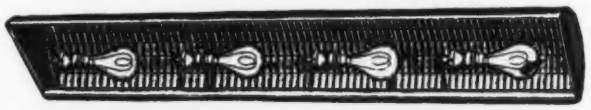

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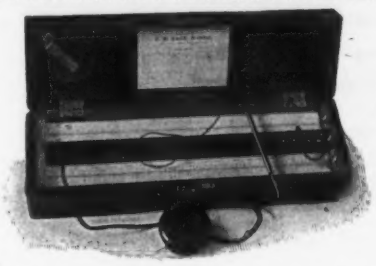

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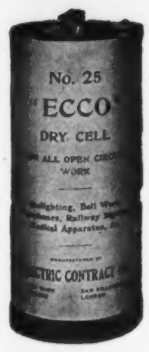

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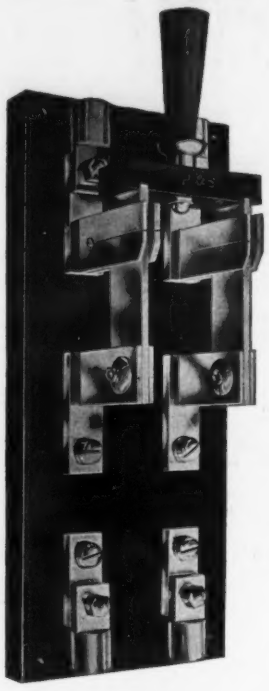

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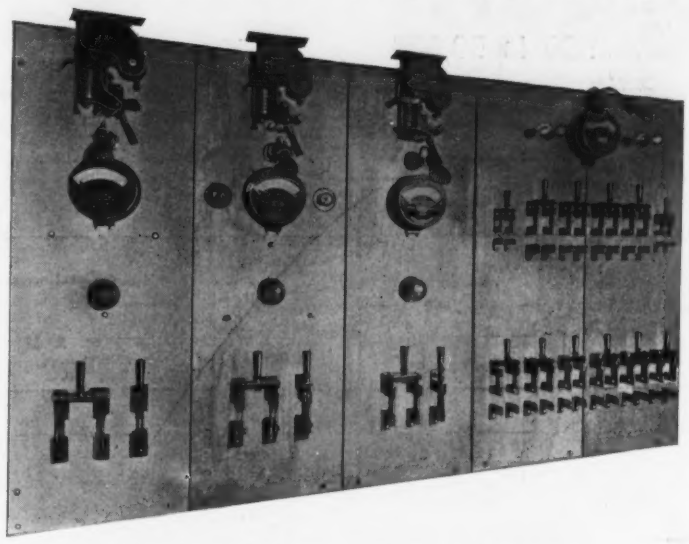

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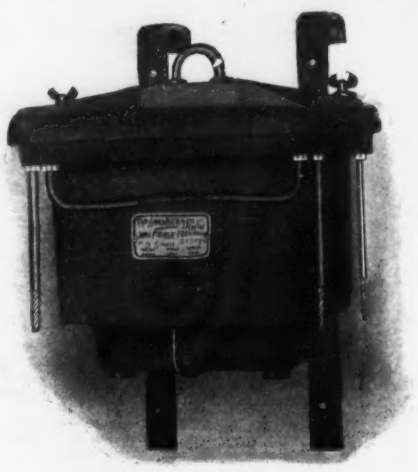

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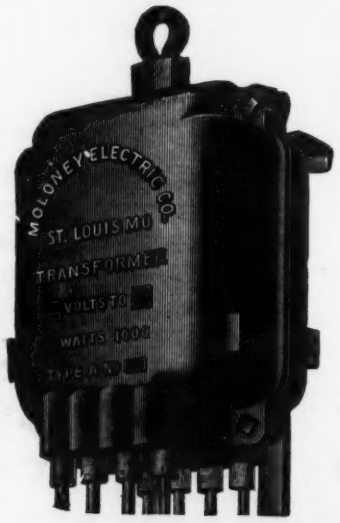

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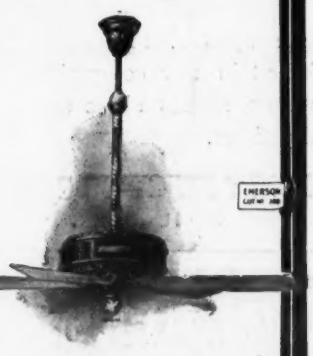

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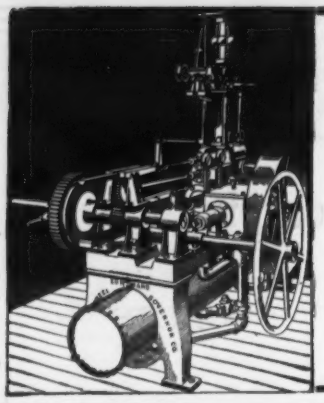

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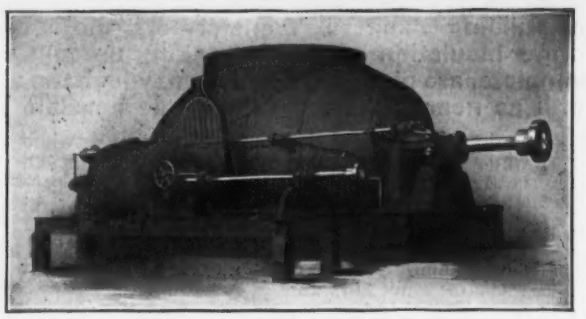

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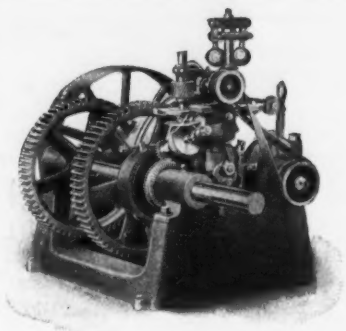

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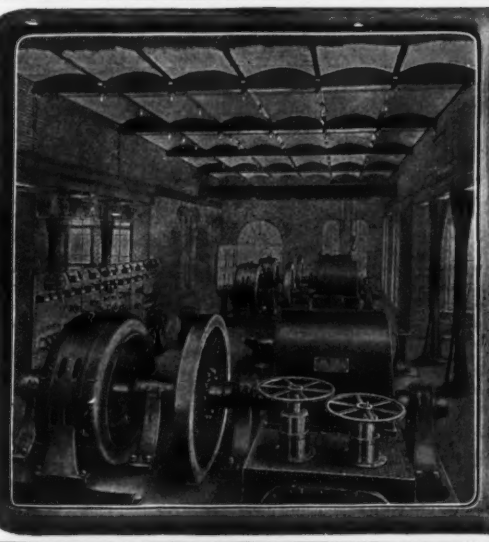

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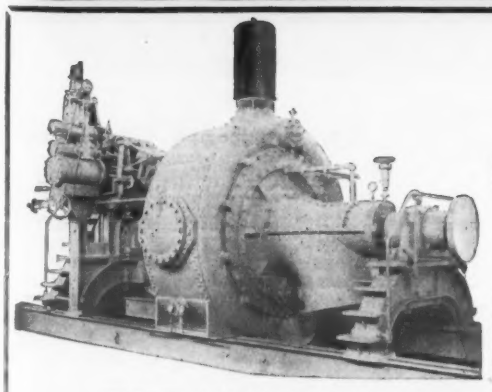

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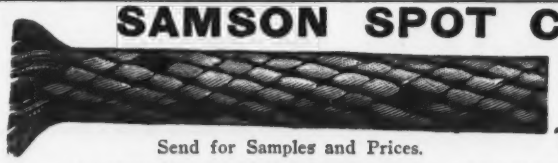

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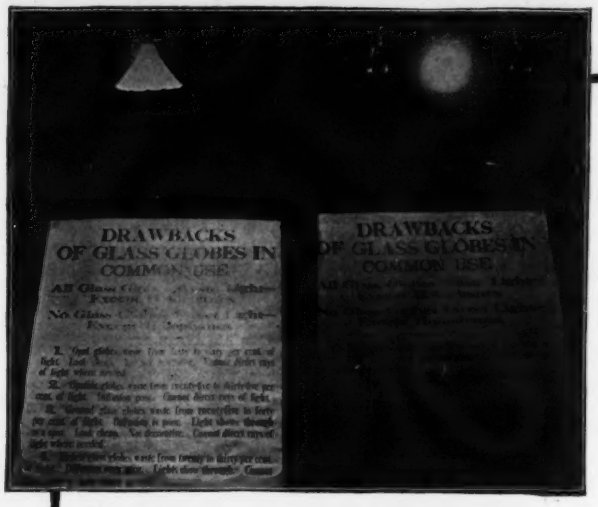

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